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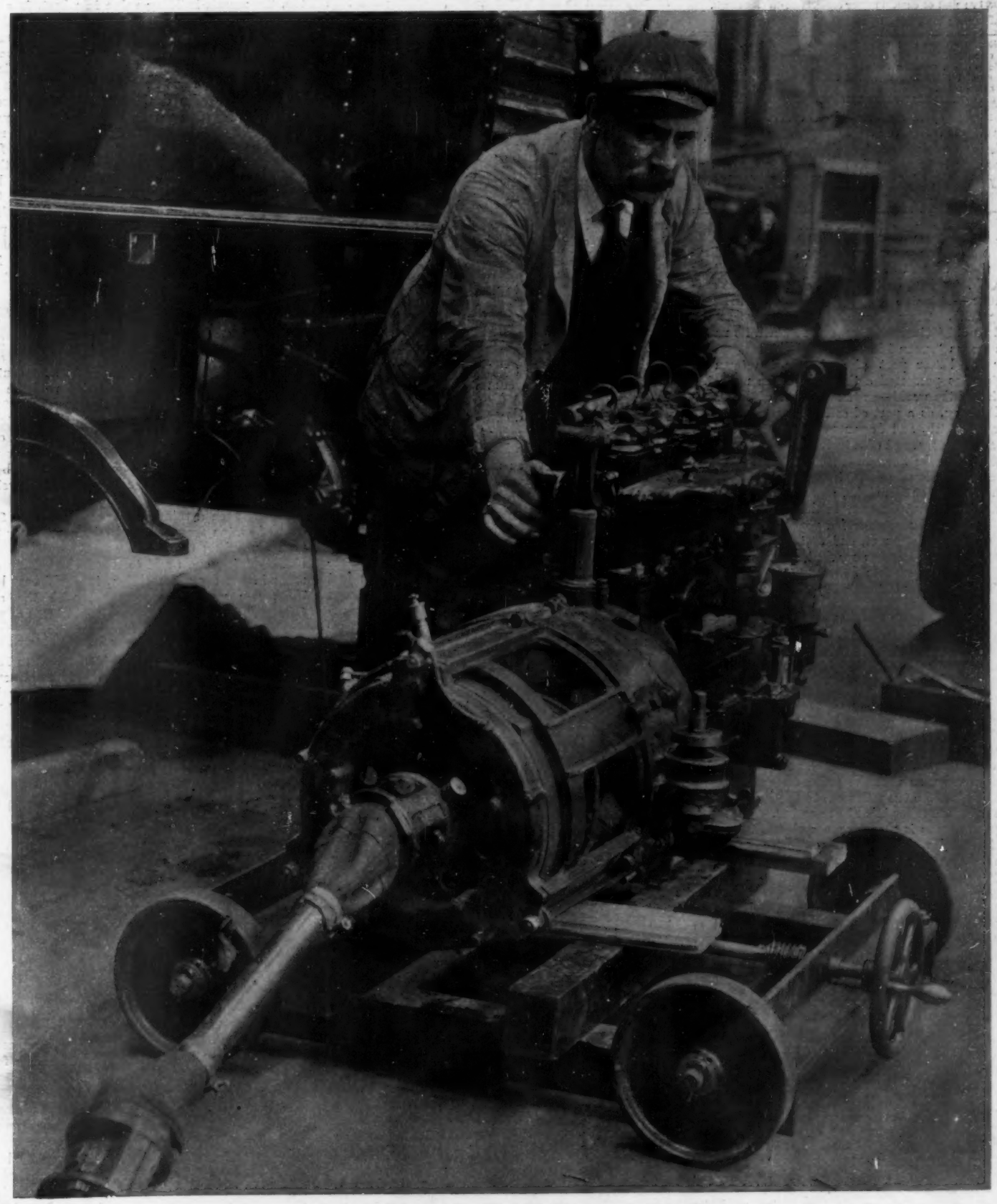

A twelve-horse-power gasoline motor and dynamotor coupled together.

THE MOTOR OF A GASOLINE-ELECTRIC OMNIBUS.—[See page 244.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Wanted—An American Atlas

ABOUT ten years ago the government of Germany began to build, in its "leased" territory of Kiaochau, on the China coast, a great seaport town—Tsingtao (or, as the Germans write it, "Tsingtau"). They selected for this purpose the site of an old Chinese village, and retained its name, which means "green islands."

For the better part of a decade the town of Tsingtao has possessed a threefold claim upon the attention of the world—as the terminus of the Shantung Railway, as a port of call for several lines of German, British, and Japanese steamships, and as the seat of government of a thriving German colony. Millions of marks have been spent on the wharves and docks, hospitals, administrative buildings, fortifications, shops, offices, clubs, and dwellings of this, the most important German settlement in the Far East. In 1907 Tsingtao had a population of 1,484 Europeans, 171 Japanese, and 31,500 Chinese. In the same year its imports reached a value of $36,448,593, and its exports $15,143,847. The ships entering the port numbered 499, with an aggregate tonnage of 546,843.

Let us now open the largest and latest atlas issued by the best-known map-publishing house in America—conspicuously dated "1910" on the cover and title page—and seek for Tsingtau. We do not find it! We find a map of the China coast, drawn with a crudity of outline that is apparent, even if we do not take the trouble to place this American commercial product alongside of the authoritative official charts of our own and foreign governments. Even the coloring of the map offends our eye by failing to "register" properly, so that the green hatching of the land extends some ten miles out to sea at one point and retreats ten miles inland at another. The Kiaochau protectorate is shown on a scale so large that space is found within it for recording the location of five unimportant Chinese towns and villages. But of Tsingtau not a trace.

All this is illustrative, and serves to explain why educated Americans long since ceased to take the American-made atlas seriously. The American atlas is made to sell, and unfortunately it does sell to the undiscriminating majority. The fault lies with the public, not with the publisher. Better things are demanded of the publisher abroad, and the result, so far as unofficial map making is concerned, is seen in the beautiful and authoritative atlases of Stieler, Berghaus, Debes, Bartholomew, Stanford, and Keith Johnston.

"Having Eyes, They See Not"

IN spite of the emphasis that up-to-date pedagogy lays upon the training of the powers of observation, it remains true that the average man is decidedly blinder than the much-maligned bat to the details of almost every picture in Nature's gallery, whether by land, or sea, or sky.

Suppose a new star, as bright as Sirius, made its appearance in Bootes, or Andromeda, or Cygnus. Suppose Sirius himself vanished from the firmament. How many people would notice the change in the celestial picture? Suppose, by some stupendous miracle, *all* the stars were shifted about, like the bits of glass in a kaleidoscope, and grouped in new constellations. How many men of the class that calls itself "educated" would, from personal observation, gather the slightest inkling of what had taken place?

What proportion of the community, beyond schoolboy age, can tell the order of the colors in the rainbow? Most of us once acquired this bit of information from a book, and speedily forgot it; for the information was never verified and fixed in our minds by an examination of the rainbow itself.

Vicarious observation is an indolent habit common to all classes. Scientific men are prone to it. Even painters, who, so to speak, live by their eyes, are, as Ruskin has vehemently told us, blinded by convention to the most obvious facts of Nature. The lessons of Ruskin, and of others who have preached sincerity in art, need to be reiterated to-day. The crescent moon is still frequently painted with her horns turned to the west; notwithstanding the fact that this particular piece of imbecility on the part of the artists has been denounced again and again. The midnight sky is still shown with its stars scattered about wherever the caprice of the artist chooses to put them. To one who knows the constellations no amount of beauty in the *ensemble* can save the effect of such a picture from being grotesque. As well represent a herd of cattle adorned with wings, or the Madonna with a superfluous nose.

Frank conventionalizing is well enough. No one expects the flowers in a wall-paper pattern to have much in common with those depicted in botanical textbooks. But art that aspires to be more than decoration cannot profitably dispense with the knowledge derived from accurate observation. The distinction lies in the fact that the conventional design does not pretend to portray Nature, while the painting of impossible moons and stars does; and we are repelled by the display of the artist's ignorance, or perhaps by what we feel to be his assumption of our own.

John Burroughs has pointed out that American poets are prone to pervert natural history by transplanting the fauna and flora of Europe across the Atlantic. The skylark, of heavenly voice, is a part of the poet's stock-in-trade; but in a poem the *locale* of which happens to be Iowa, or Nebraska, or Tennessee, he is exactly as much out of place as the roc or the dodo. Some of our poets appear to think that he is, to all intents and purposes, the same thing as the meadowlark—they are both "larks." This is like expecting pineapples to grow on pine trees.

Nature lies close about us, from infancy to old age. Books are not wanting to enable us to interpret her. In fact, the literature of Nature is just now enjoying an unprecedented vogue. The books are indispensable, even if they serve no other purpose than to supply us with our vocabulary—to enable us to name what we see. But let us not trust to books alone, or chiefly. Let us use our eyes.

Let us apply the great art of observation, instead of merely preaching about it.

Linking the City Sewer to the Farm

WHEN New York City is now geographically described as "a city surrounded by sewage," and Chicago is sending her sewage down to St. Louis, *en grosse*, and St. Louis is depending upon its oxygenation, during the flowage, and on settling and filtration beds; and when New York's river and bay bottoms are estimated to hold sewage solids a foot or more thick, we certainly are confronted with a condition not with a theory.

The New York Sanitary Commission and some conservative and skilled engineers are giving the sewage problem much attention.

If the sewage can not indefinitely be sent down the bay, at the rate of seven hundred million gallons daily, to be carried back and forth with every shifting tide, then where is the solution?

When Liebig and Crookes bewailed the annual loss of millions of dollars of sewage sent into the sea instead of being utilized upon the farms, describing it as the great crime economic of modern civilization, they did so with good reason.

Commissions are sitting in session studying how to increase our wheat yields, and when our average yield per acre is 13 bushels as against England's 32 and Germany's 28 bushel average, there is need for it along the lines of reducing the higher cost of living.

Intensive farming will solve many agricultural problems confronting us to-day. Instead of the 160-acre farm, the 20 or 40-acre farm, tilled to the limit of intelligence, industry and fertilization, and yielding more revenue than the larger area is to come.

The "Wheat King" and "Cattle Baron" have had their day and the five, ten, and twenty-acre farm has come to stay. It was the pocket handkerchief farmer who from his savings enabled the French government to pay off the unheard of German war indemnity in record time. The French peasant, who intensively cultivated his farm and got every ounce of produce the earth could be made to yield, saved the day financially for France.

The days of 160 and 640-acre wheat farms and an average yield of 13 bushels to the acre must cease and better conditions rule. The wheat farmer, the laziest of all farmers, must at last give his soil a "square deal," rotate his crops, and refertilize his land. The ruling method of cropping wheat year after year from the gradually nitrogen-exhausted soil must cease. There is little virgin prairie land still to take up and begin cropping wheat *de novo*. He must rehabilitate the land he has.

The fact stands that from a nitrogen free soil successful wheat growing cannot be followed. Gluten, the muscle-building value in wheat, is a nitrogenous body, and it must draw from the nitrogen of the soil. The farmer's wheat crop becomes reduced in the ratio to the nitrogenous depletion of the land.

Liebig demonstrated the utility of connecting the sewer with the farm in an experiment made years ago in the Jardin des Plants. He manured two stands of growing wheat, one with cow's manure, low in nitrogen, the other with human urine, rich in nitrogen. When the wheat was analyzed the former showed a presence of 10 per cent of gluten, the latter 31 per cent. Allowing 60 pounds to the bushel of wheat the gluten contents of our wheat to-day would average 6 pounds to the bushel, although some of the autumn wheats have run as high as 12 pounds to the bushel. A content of 30 per cent would give us 18 pounds of nitrogenous matter, gluten, in our wheat to the bushel, if the Liebig experiment could be made to hold good in practice.

The importance of increasing the gluten content in our wheat may be pointed out in a convincing comparative way. Round steak may average 20 per cent of protein, albumen and fibrin, call it animal "gluten" to the pound. If steak be 25 cents per pound, then the reconstructive tissue of the steak, the real food, muscle value, costs us $1.25 per pound. The comparative value of wheat gluten and animal "gluten," represented by the lean of the roast or the steak, physiologists undoubtedly would prefer the wheat gluten, pound for pound, because of its digestibility for other digestive and physiological reasons.

But if such a thing were possible to get 30 per cent of gluten from a barrel of flour costing $6.00, then discarding the starch as an energy producer, and confining one's self to the flesh and blood element in the flour, the gluten, it would cost but 10 cents per pound as compared with the animal "gluten," the albumen and fibrin, at $1.25 per pound.

Millions of dollars in sewage value, nitrogenous fertilizer, are being wasted annually. Would the increasing of our wheat yield 50 per cent to 100 per cent, and perhaps the increasing of the gluten content 25 per cent and upward, represent a value in dollars and cents sufficient to warrant a linking of the sewer and the grain field? And what problems does this linking up mean to the engineer? He must solve the problem of sewage disposal by either pipe-lining it far out to sea or in either a liquid or dry state transferring it where it will do the most good, to the farm. The matter seems to be now up to the sanitary engineer, and with the above figures applied to our wheat and grain crop, to say nothing of other farm products, it is something for the engineers to think over.

The New Oceanographic Institute at Paris

THE official opening of the Oceanographic Institute took place recently at Paris. It will be remembered that the institution was founded by the Prince of Monaco and the present building was donated by him to the University, together with a large endowment fund. It is a handsome edifice of several stories, erected in the university quarter, and contains a number of laboratories and lecture rooms for use in oceanographic work. The similar oceanographic laboratory of Monaco will work conjointly with it, and Paris will now be the headquarters for the combined institution. The aim is to carry out work in the laboratories in connection with ocean explorations and finds, and to interest the public by museums and courses of lectures on such subjects. Publications of the research work are to be issued. Corresponding members have been selected among the most eminent scientists of different countries. Among these is M. Nansen, the Arctic explorer. The Prince of Monaco expects to be actively engaged in oceanographic expeditions with his vessel the "Princesse Alice," as heretofore, and this work will now have an increased scope.

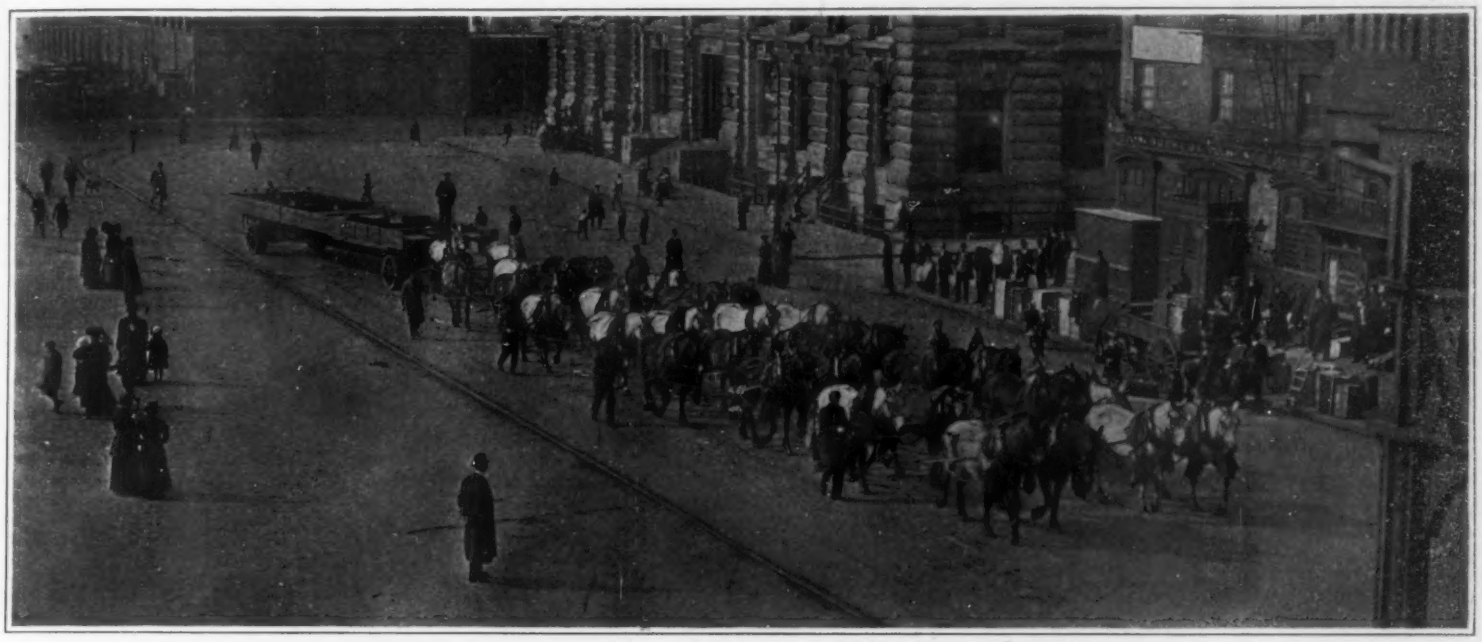
Giant Girders in the New Municipal Building

Hauling 50 Tons of Steel Through New York

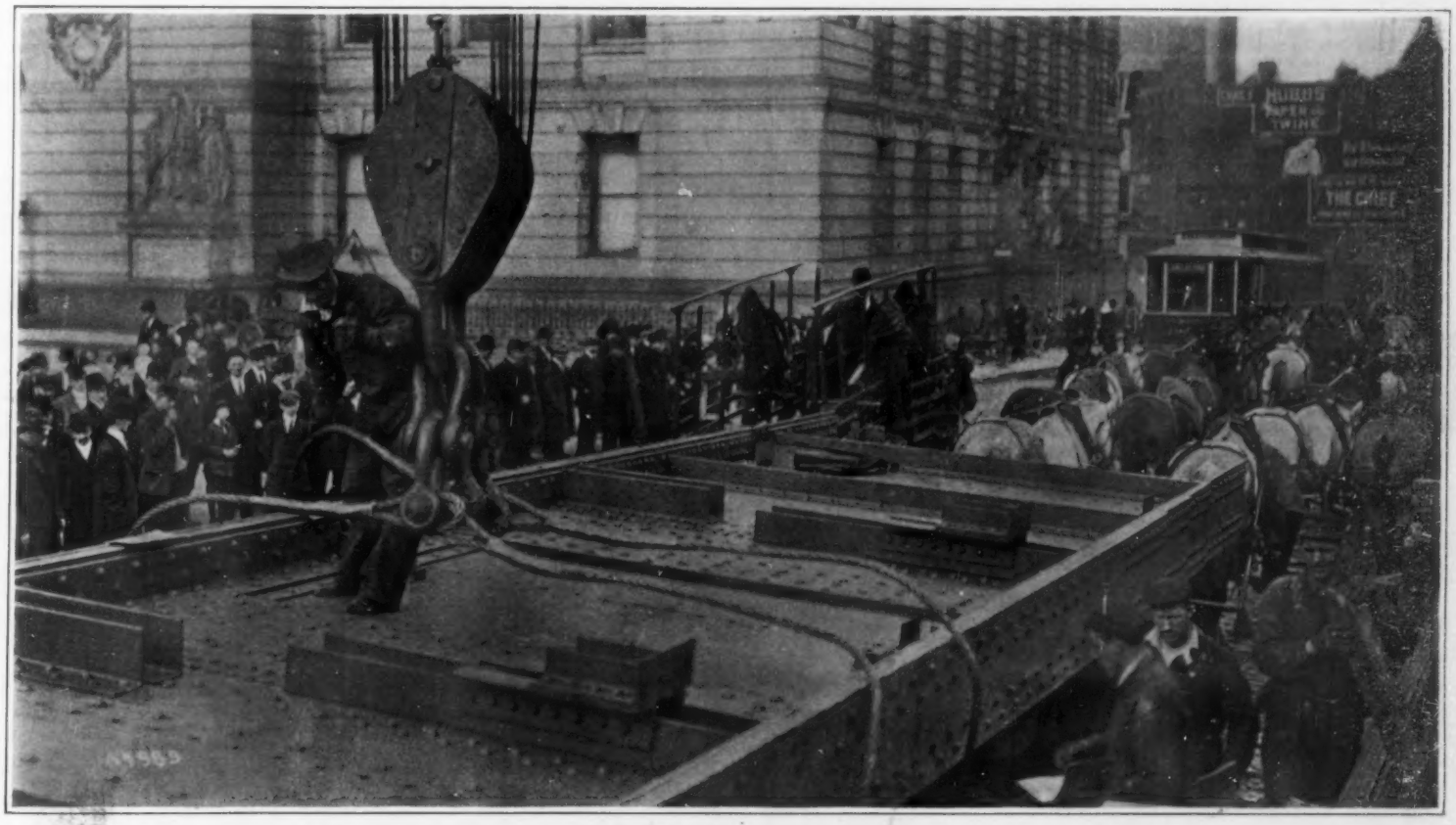
OUR readers will have heard through the daily papers of some of the difficulties which arise in the transportation of the great girders that span the arch over Chambers Street in the new Municipal Building now under construction. The task of hauling a dozen fifty-ton girders from the Battery through the streets of New York to the building site is not to be spoken of lightly. Our illustrations give some idea of the magnitude of the transportation problem involved. The girders have to be trucked one by one with a team of some thirty-four horses. Fortunately the route is almost a straight line, for the operation of turning corners with such a team and load would present no slight dif culty. The police regulations do not ordinarily allow the passage through the streets of teams numbering much over a dozen horses, owing to the serious blocking of the traffic which would result. For this reason the work of hauling has to be done on a Sunday—one-half of the task having been accomplished on the last Sunday in February, while the remainder was completed on March 5th. Our second illustration shows the preparations for hoisting the girder off the truck.

There are in all twelve of these girders, each measuring 10 feet in depth and 47½ feet in length. They form the supporting structure above the arch over Chambers Street, on the level of the fourth floor. Three of them are united into one body, which will carry a load of some 3,000 tons when the building is completed.

Our day is the day of gigantic enterprises, and our city the city of giant buildings. The new Municipal Hall which is rising upon the site at the foot of Brooklyn Bridge will be a fitting representative of the spirit and substance of New York, a spirit which may be said to find its expression even in such "details" as the fifty-ton girders under which the traffic will pass in safety through the very heart of this great city.



Hauling one of the girders from Pier 1 to the building site at the foot of Brooklyn Bridge.



Preparing to unload the 50-ton girder.

GIANT GIRDERS IN THE NEW MUNICIPAL BUILDING

Manhattan's Firewall

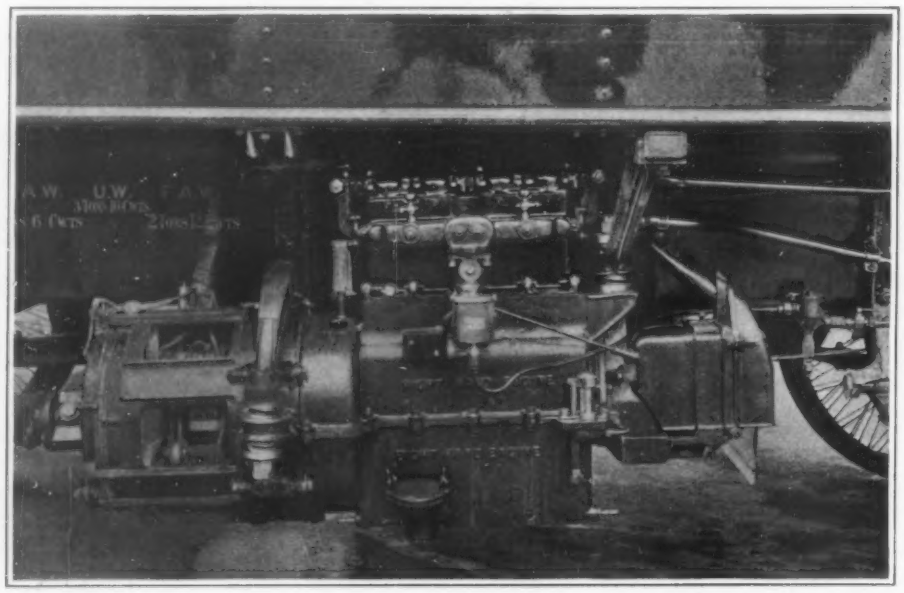
A FIREWALL, stretching across Manhattan Island from Ninth to Seventh Avenue, has been completed by the construction of the Pennsylvania station and adjacent buildings, and insurance engineers say a conflagration such as was experienced in Baltimore and San Francisco is now an impossibility in Manhattan. The area covered is something over twenty-eight acres with three levels below the main floor, the lowest being 36 feet below the street line. Approximately, there are three miles of piping, with 117 hose connections, twenty-four roof hydrants, and twelve flush hydrants. The fire brigade organization comprises twenty-five men, divided into three companies, viz., hose wagon company, chemical engine company, and standpipe company. In addition, five men, who are expected to report at all fires in advance of the regular companies, are especially designated for hand fire extinguishers. Special provision is made for plumbers and electricians to report at all fires, being subject to the orders of the fire marshal, and certain of the elevator lifts are designated for transporting the apparatus when required on upper floors. A unique feature is found in the tunnel alarms for transmitting signals indicating fire and for cutting off current to the power rails. There are 116 boxes on this system divided into six circuits, each box having two levers, one marked "power" and the other "fire," the "power" lever automatically cutting off all power current in the section directly affected. The watchman's service is recorded on two portable watchmen's clocks from thirty-eight stations, and provides for hourly tours.

London's New Gasoline-electric Omnibus

How Three Inventions Were Combined to Make an Automobile

By the English Correspondent of the Scientific American

THOUGH the motor bus has practically displaced the horse-drawn vehicle in the streets of London, and the majority of other British cities and towns, perfection has by no means been attained. The general type of vehicle is cumbersome, unwieldy and noisy, while its control is not all that could be desired, despite the perfection of details. Some two or three years ago efforts were made to introduce a combined gasoliné motor electric drive with a view to eliminating the drawbacks of the gasoline system, but these experiments were not successful. Now, however, owing to the public outcry against the motor omnibus, the problem has been further investigated, and the Daimler company have evolved a new vehicle, which has recently been tested and which has been found eminently satisfactory. The system adopted is that known as the "K. P. L.," from the fact that it is constructed upon the Daimler-Knight, Pieper, and Lanchester patents. The vehicle and its propelling mechanism contain many ingenious features, the construction itself being carried out upon entirely new lines.



One driving unit, showing situation at side of vehicle.

Instead of employing a chassis to which the superstructure is attached, the vehicle is in reality a homogeneous whole, there being no frame in the accepted sense of the word, this being abandoned in favor of a trough rolled from sheet-steel and extending the full length and width of body. Channeled transverse members are riveted where necessary to this foundation, as are also the main members supporting the roof.

The most interesting feature, however, is the design and construction of the propelling equipment. There are two distinct power units, consisting of gasoline motors and electric dynamotors, a secondary battery being held in reserve. By this arrangement considerable mechanism is dispensed with, such as change-speed gearing and back axle differential, the drive being direct to each of the two driving wheels. The propelling mechanism is suspended on brackets attached to the steel trough foundation on either side, in the space beneath the passengers' seats.

Each driving unit comprises a 12-horse-power, four-cylinder Daimler-Knight gasoline motor to which is coupled a shunt-wound six-pole dynamotor rated at 3 kilowatts, but having a "give and take" capacity three or four times in excess of this rating. The dynamotor is bolted to an extension of the crank case and base chamber of the gasoline engine, so that the combination is perfectly rigid. From each set extends a universally jointed shaft, which engages with its respective driving road wheel by means of worm gearing to two short live axles carrying the rear wheels of the vehicle. By this arrangement the ordinary differential is supplanted by an electric balancing system. The water circulation for cooling the gasoline motors is provided with a radiator carried in the front of the vehicle, to which both engines are connected, the pump being driven by a small half-horse-power electric motor. Each of the power units is moreover fitted with a magnetic clutch and a brake.

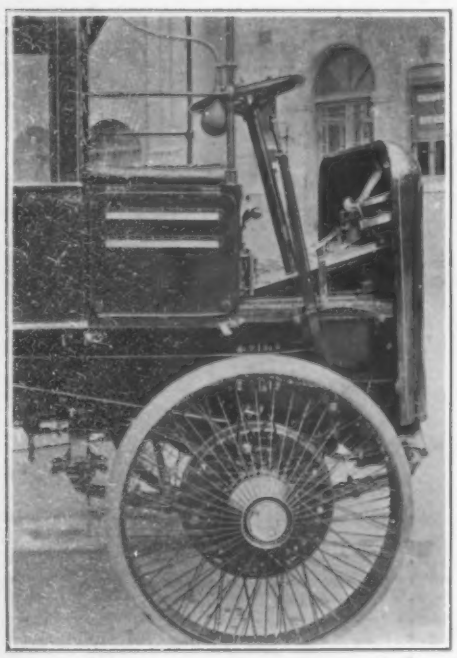
When the vehicle is running light the drive is by the gasoline motors, the dynamotors acting as dynamos charging the secondary battery, consisting of 25 cells of the Tudor pattern carried beneath the driver's seat, and having an aggregate weight of 560 pounds. Hitherto the inclusion of an accumulator set has been regarded as impossible in a gasoline-electric driven motor bus, owing to the great increase of weight which it represented, but experience in this case has demonstrated that such is imperative, and that it conduces very appreciably to the running efficiency of the car. When any extra load is imposed upon the engines the battery comes automatically into action driving the dynamotors which thus become converted into motors, thereby materially increasing the horse-power rating of the vehicle. In the earlier experiments a higher-powered gasoline motor was utilized, but it was found to be too powerful, the accumulators only being brought into action to assist propulsion up gradients of 12½ per cent. By reducing this engine to 12 horse-power the work was more equably divided, with appreciable economy in the consumption of fuel.

By this system the control of the bus is rendered very simple. In starting up, the accumulators are switched in, the drive being electric. The dynamotors immediately start up the gasoline engines which take up the drive to the road wheels, the dynamotors reverting to the charging of the accumulators unless the load is heavy. On the steering wheel are mounted two control levers. One engages with the throttles of the two gasoline engines, the other with a common rheostat regulating the fields of the dynamotors. A solenoid automatically governs the changing of the dynamotors from motors to dynamos and *vice versa* according to the load imposed upon the driving mechanism. This solenoid acts upon the throttles of the carburetters, closing them as the accumulators become charged, thereby reducing the speed of the gasoline motors, and reopening them as the energy from the accumulators is consumed, thereby speeding up the engines and also the dynamos. When the traveling is forward the dynamotors are in parallel, and reversing is entirely effected by the electric drive, for which purpose the dynamotors are placed in series, there being a small lever beside the driver by which changing from parallel to series working or *vice versa* is secured, the lever only being used when it is desired to reverse.

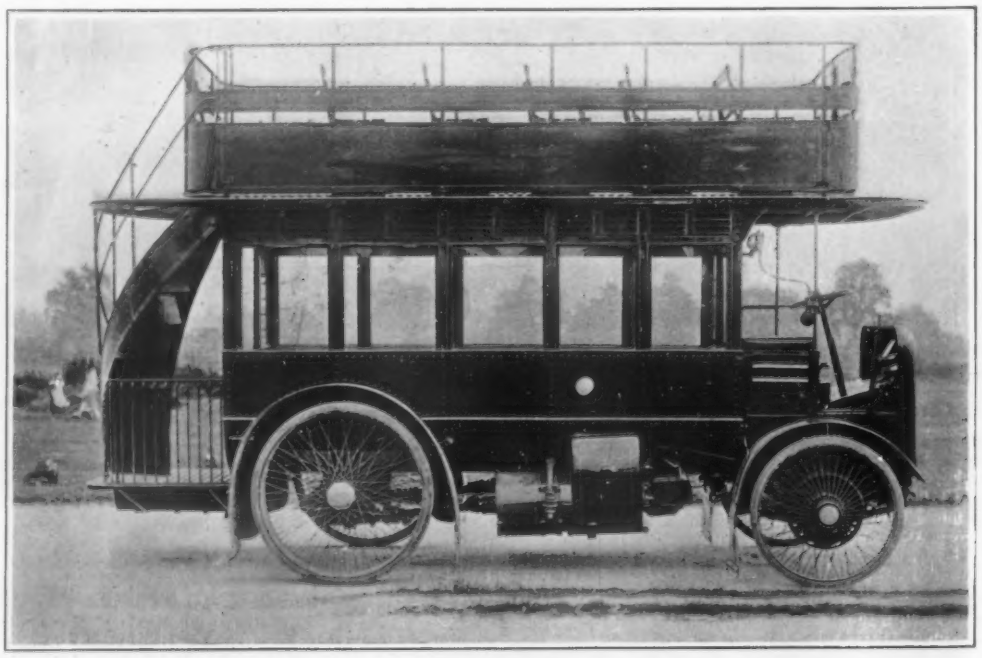
The wheels are of large diameter and are of the Rudge Whitworth wire type, which are lighter and stronger than the wooden wheels generally employed, a system of double spoking having been adopted to render these wheels capable of operation with such a heavy vehicle. The car is fitted with ample braking effort, all four wheels being braked, and four distinct methods of achieving this end are provided. There are foot and hand brakes to the front wheels, magnetic brakes on the cardan shafts operated by a pedal which also declutches the engines before the application of the brakes, and a system whereby the momentum of the vehicle is absorbed by charging the battery, this last being highly efficient. The vehicle is well mounted, and motor vibration is absorbed by powerful springs which prevent its communication to the passengers within.

The gasoline-electric drive possesses many advantages over the simple gasoline motor system. In the first place the over-all length of the vehicle can be appreciably reduced, without interference with the passenger seating accommodation. Then again the bus starts off more smoothly, there being no signs of violent jerks; running

(Continued on page 259.)



The dashboard and front wire wheel.



London's new gasoline-electric omnibus.

A COMBINATION OF THE KNIGHT, PIEPER AND LANCHESTER PATENTS

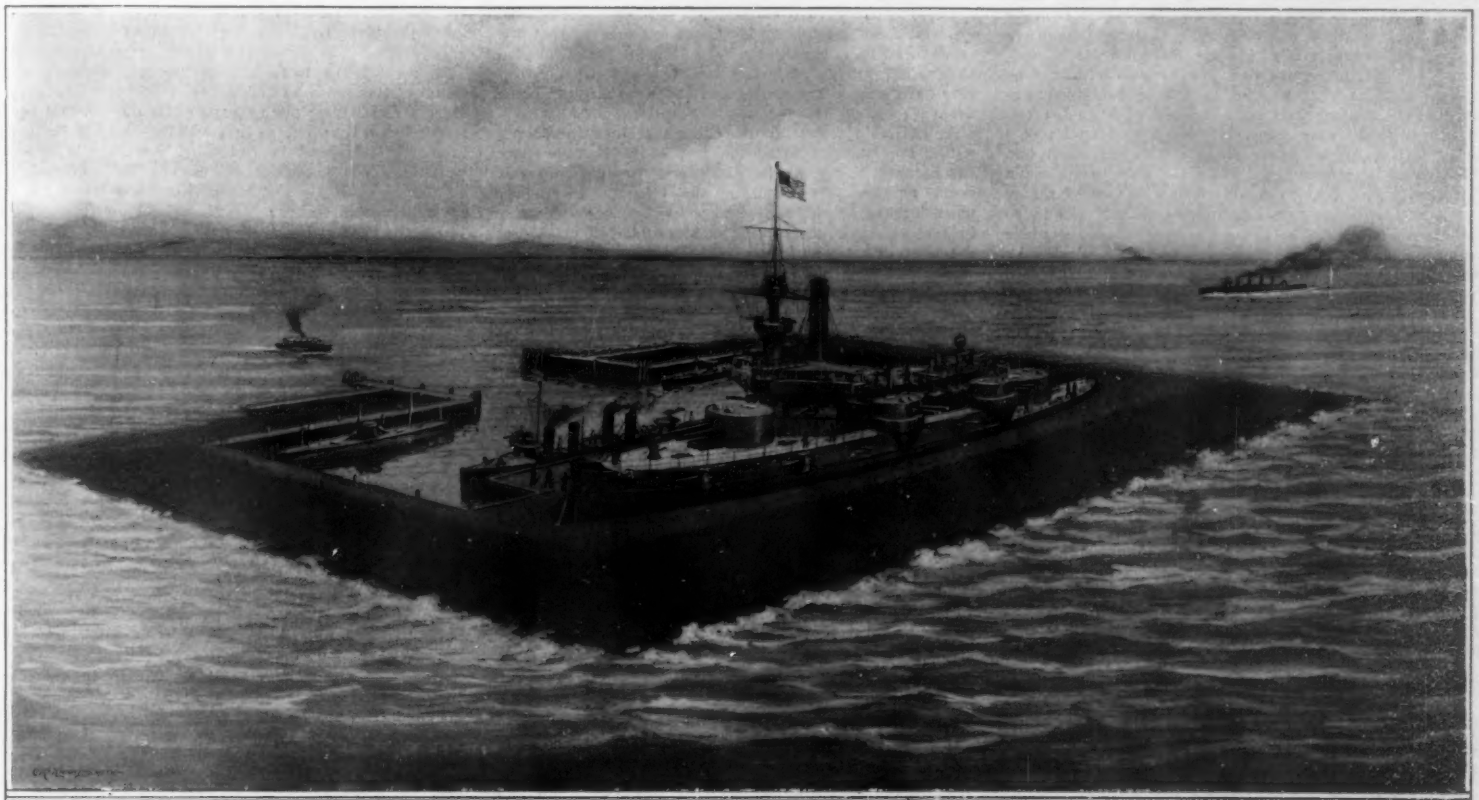
Old Battleships as Permanent Forts

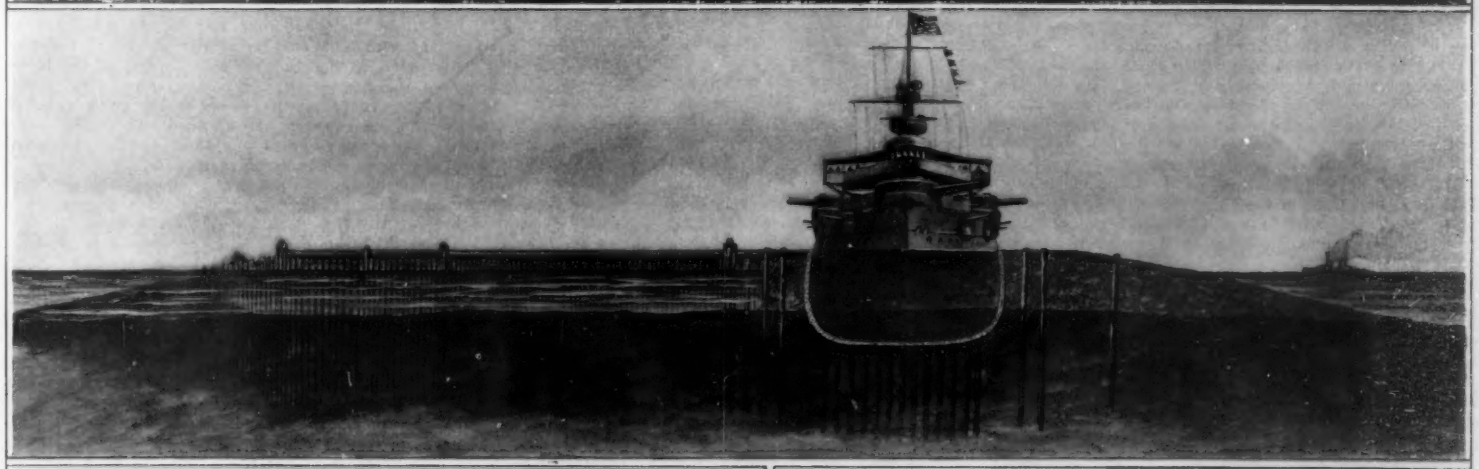
Coast Defenses Versus the Scrap Heap

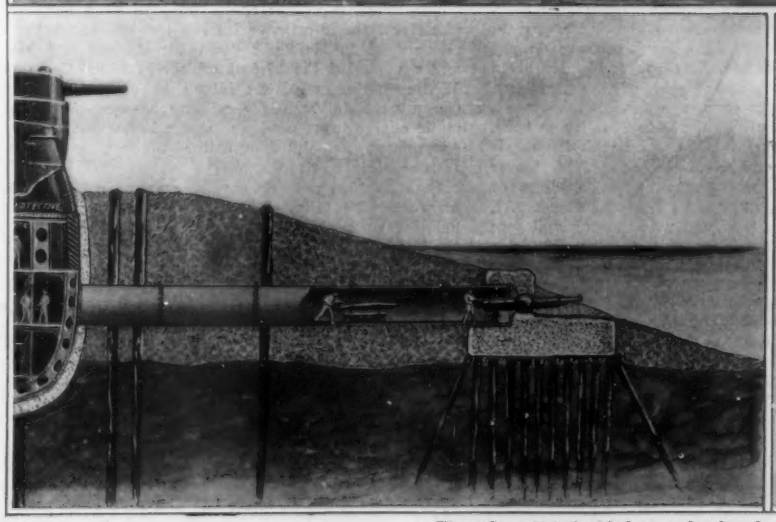
A BATTLESHIP, costing ten to twelve million dollars, is becoming obsolete after seven to ten years of service, and after twenty years of life, it is, for deep sea fighting, practically useless. The deterioration is chiefly in the speed, and somewhat less in the armament, the fighting range of the older guns being less than that of the modern output of our ordnance factories. The armor remains good for all time. The hull, if properly protected against corrosion, should be available for a long life of usefulness. The limitations in speed and in the range of the guns, soon renders a ship unable to take her place in the first fighting line, and before many years have passed, she is unavailable even for the second line. Then, this investment of from six to twelve million dollars is put up for auction and goes to the scrap heap.

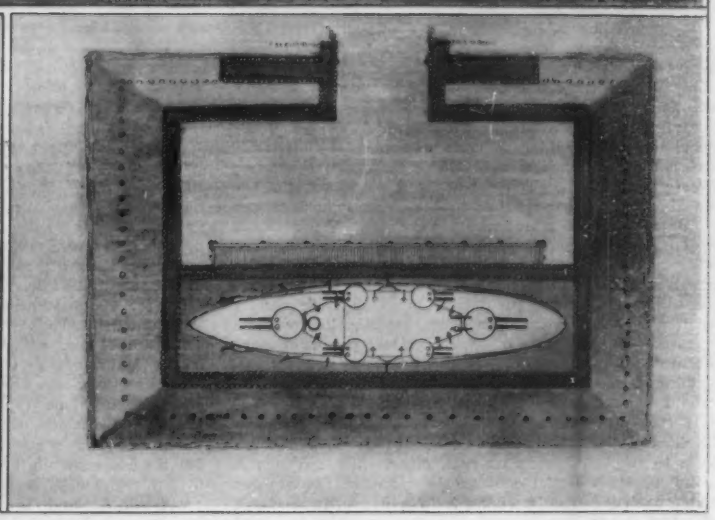
If some duty could be found for the obsolete battleship, in which a ten to fifteen thousand-yard fighting range for the guns was not indispensable, and in which speed was of no account whatever, a vast amount of most valuable fighting material would be saved for military purposes. Now it has been suggested that such a sphere of usefulness can be found for our obsolete battleships by emplacing them permanently upon certain shoal grounds at the entrance to our harbors or contiguous to our waterways, and turning them into permanent, fixed, coast fortifications. We present a series of drawings showing how this might be done in the case of such a battleship, say, as the old "Iowa."

We can well believe that the up-to-date naval man who thinks in terms of 23-knot, 30,000-ton battleships, and









The "Iowa" imbedded on a shoal and commanding a harbor entrance.

Sectional view showing construction of earthworks and torpedo-boat harbor.

Tunnels for torpedo discharge would lead from ship to water.

Plan showing cofferdam, embankment, and harbor of refuge for destroyers and submarines.

OLD BATTLESHIPS AS PERMANENT FORTS

14-inch guns of 12,000 to 14,000 yards effective fighting range, will look at this presentation with a smile of amused curiosity. It is certainly hybrid; but like many another proposal of startling originality, it will be found upon closer and thoughtful attention that the suggestion has a great many valuable features, which should commend it to the earnest consideration of our army and navy.

Briefly stated, some shoal place could be selected at the entrance to a harbor, or at some other waterway to be defended, and, by means of double rows of piling, a cofferdam would be driven, of sufficient dimensions to allow the battleship to be floated within it. Previous to its entrance, however, lines of piling would be driven in the proper position to support the ship along her central and her docking keels. The mud or sand would then be dredged out, the piling cut off at the proper height, and the ship would be floated in and allowed to settle upon the bed thus provided. The cofferdam would then be closed, and sand or other suitable material would be pumped or otherwise filled in around the ship to a point well above the protective deck, or as high as might be deemed expedient. This filling would be continued seaward on the channel sides, for a distance of 60 to 100 feet, finished with an easy slope, and rip-rapped on its face to protect it against wave action. The cofferdam and filling would be extended on the lee side to inclose a rectangular basin, which would form a harbor of refuge for a fleet of destroyers and submarines. It should be explained that after the filling was completed, the whole exterior of the shell of the ship would be protected by grouting it up with cement, by the method which is used in sub-aqueous tunnels.

On the channel side, tubes would be built through the embankment from the interior of the ship to the water, with suitable concrete embrasures located below the water; and in these embrasures would be mounted torpedo discharge tubes, of the kind now installed on warships. These tubes, of course, would lead out toward the channel that is to be defended.

The advantages of this form of defense may be summarized as follows: A battleship fort will have a solid gun platform, the battleship resting solidly on the bottom and being imbedded, as described, in earth to the level of her upper deck, ordinarily 12 to 14 feet above sea level. With large-caliber guns on solid gun platforms, located at approaches, with a wide base line available for ranges, the accuracy of the gun fire of a battleship fort will be perfect and much superior to that of an enemy's attacking battleship, which must be afloat with unstable gun platform and limited range-finding facilities.

The earthwork surrounding a battleship fort will render it perfectly secure from any torpedo attack, while the tubes running out from the battleship fort will enable the fort to fire modern high-powered torpedoes with great accuracy, at any hostile battleship.

Submarine torpedo boats could also be available to reinforce the battleship fort to render any attack by the enemy's battleship hopeless.

Very little damage could be inflicted on a battleship fort by the gun fire of any enemy, but the enemy's battleship could be sunk by gun fire of a battleship fort.

In every respect of defensive and offensive defensive except pursuit of the enemy, a battleship fort has the most decided advantage, so much so that it is highly improbable that any battleship would ever engage a battleship fort, except incidentally in an effort to run by and get into our ports, with least possible exposure to the fire of the fort.

The battleship fort is therefore the most formidable type of coast defense fortification; so much so that the existence of an adequate number of such defenses, located at strategic points at the approaches, will probably insure such a port immunity from any attack by a hostile fleet.

A battleship fort with propelling machinery and navigating appliances removed will have in itself ample space for barracks for a garrison of one or two companies of coast artillery, quarters for the officers, storerooms, magazines, and shell rooms, and reservoirs for fresh water in her double bottom compartments; while all machinery for operating turrets, ammunition supply, electric light, power and heat will be retained in the battleship when installed as a battleship fort.

All battleships are provided with a ventilating system that supplies fresh air and exhausts foul air in all compartments of the ship; so that the sanitary conditions are equal and in many respects superior to those of any installed as a fortification.

The Navy Department is loth to give up the older battleships to the army, as they want to use them for training the navy militia; but, at present, they cannot use them for this purpose for lack of funds and shortage of naval officers. Moreover, only a very small force of organized state naval militia is available to man more than a very few of the sixteen old battleships and monitors now on the navy list and not serviceable in a modern fleet of up-to-date battleships.

The navy has the following ships which are not efficient to serve in the first line of battleships and which could be converted into the most formidable type of battleship forts.

1, "Alabama"; 2, "Illinois"; 3, "Indiana"; 4, "Iowa"; 5, "Kearsarge"; 6, "Kentucky"; 7, "Massachusetts"; 8, "Oregon"; 9, "Wisconsin"; 10, "Ozark"; 11, "Tonopah"; 12, "Tallahassee"; 13, "Cheyenne"; 14, "Puritan."

Recent reports show a deplorable lack of necessary armament and equipment for our coast defenses, and the acquisition of these fourteen older battleships and monitors would supply a large measure of the deficiencies and provide formidable fortifications to approaches to our ports that are now not so provided.

Four of these battleships could be used to protect and defend approaches to the Panama Canal. The approaches on the Pacific can be most readily provided with battleships because the Gulf of Panama is shallow and two such battleship forts could be advantageously located several miles from Panama. On the Atlantic side there will be some difficulty to find suitable sites; but two such forts can be placed in more advanced positions than any fortifications of the present type that could be built on the land. Such battleship forts could be installed at the approaches to our harbors in less than 100 working days.

At the entrance to the Chesapeake Bay the deep water channel runs close to the sandy beach at Cape Henry. Here a rectangular ditch can be easily dug on that beach, strengthened by piling so that a battleship may be hauled in at high tide and be embedded permanently in earth work at a position which will defend the approaches to the Chesapeake Bay. This defense may be reinforced by a battleship fort on Nautilus Shoal off Cape Charles to assist in defending the entrance.

Submerged torpedo tubes can be extended from the imbedded battleship fort out through the earth with adequate provisions to accurately discharge the most improved automobile torpedoes at an enemy trying to force a passage.

Similar battleship forts can be installed at Delaware Capes, at the entrance to New York, Long Island Sound, Massachusetts Bay, Puget Sound, Golden Gate, San Francisco, San Diego, Cal., Straits of Florida, Honolulu, and Manila Bay.

Our battleships will gradually become older and obsolete, and from time to time additional battleships will no longer be serviceable for even the second or third line of mobile defense. Their utilization in the way suggested will provide coast defenses which, being reinforced with earth protection, are and will always constitute a powerful defense.

The country demands adequate protection not only by having command of the sea but also by having adequate coast defenses at approaches to our sea ports and not within our harbors.

Correspondence

Locating the Pole by Daylight Observations of Venus

To the Editor of the SCIENTIFIC AMERICAN:

Standing at the north pole of the earth, the dome of the heavens would appear to be stationary. There would be no rising or setting of stars. During the long polar night of nearly six months the only stars visible would be those lying north to the celestial equator. The horizon and the celestial equator would coincide.

The splendid stars Sirius, Antares, Rigel, Spica, Fomalhaut and those in the Girdle of Orion would never be seen. Vega's altitude would always remain 38 degrees and 41 minutes above the horizon, and Betelgeuse would remain at 7 degrees and 23 minutes. The moon and the planets would be visible only when they were north of the equator.

The chief point of this article is to point out that the planet Venus could be used in full daylight to direct the explorer to the pole and to accurately indicate when the pole had been reached. It is perpetual day at the north pole from March to September, and, of course, the fixed stars are invisible during that period. Therefore, the positions of explorers in the polar regions have been determined by solar observations.

It is well known, however, that Venus when near her greatest brilliancy can easily be seen in full sunlight with the naked eye. Hence, at the pole, when Venus is well north of the equator, she is at times continuously in view for weeks.

Had Cook been at the north pole on April 21st, 1908, as claimed, he would have been able to see Venus without a glass. Venus was at that time approaching her greatest brilliancy, which she attained on May 29th. On April 21st, 1908, her altitude above the polar horizon was 25 degrees and 58 minutes, and she crossed the meridian of Greenwich 3 hours and 4 minutes after the sun. The altitude of the sun at noon on that date was only 11 degrees and 49 minutes above the horizon. Daylight observations of Venus would give more accurate results than observations of the sun for the following reasons:

First.—The smallness of her disk would permit of more accurate observations.

Second.—On account of her higher altitude refraction would be much less than in solar observations.

Third.—Eye strain due to solar observations would be avoided. Double observations of Venus and the sun could also be used as checks on each other. When Venus is south of the celestial equator she could be used in the same manner for determining south polar latitude and in locating the south pole.

When Peary was at the pole April 6th, 1909, Venus was favorably placed and could be seen. In the current number of *Popular Astronomy* there is an article on the "Visibility of Venus by Daylight" by Prof. Fath, of the Solar Observatory, in which he says that during one elongation in 1910, "Venus was visible in full daylight to the unaided eyes for 216 days, very nearly a complete sidereal period. . . . The only precautions taken at any time were to have the eyes in the shadow of a building, post, or similar object." He found that only four days after inferior conjunction with the sun, the planet became visible in the day time to the naked eye. It will thus be seen that in this latitude Venus was visible in sunlight during nearly two-thirds of the year 1910.

Indianapolis, Ind. JOHN CANDEE DEAN.

The New York Motor Boat Show

FOR the seventh year an exhibition of motor boats, engines and accessories was held recently in Madison Square Garden. Of the 123 separate exhibitors, 17 were boat builders, 49 engine manufacturers, and 57 accessory makers. The engines and accessories filled the greater part of the ample space available in the Garden.

Although most of the progress made in the last twelvemonth has consisted of refinements in details, there has been a decided classifying of the hulls for the various uses for which they are intended. In the cruiser class particularly, the increased use for short one-day or week-end trips has led to the lowering of the raised deck in front, in order to obtain a less obstructed view, and more deck room; and also to the increasing in size of the cock-pit. Since these "day" cruisers do not have to stand rough weather, they are frequently given the easy lines and flat after body of the runabout. Fitted with medium-duty engines of the lighter types, these cruisers will frequently make 18 to 20 miles an hour.

As for the large cruisers at the show, with the single exception of the "Elco de Luxe," which was 54 feet over all, the limit of length was 45 feet. Two cruisers of this length were shown, as well as two of 40 feet. All were of the bridge deck type and were fine examples of the latest pleasure cruiser. The large motor yachts have increased from a maximum length of 98 feet last year to 138 and 140 feet.

As for speed launches, several excellent examples of these craft, fitted with comfortable chairs, were exhibited. They are capable of speeds in the vicinity 30 miles an hour. Many of the still faster runabouts have a V-shaped section forward with a flat after body, while boats of the hydroplane type have shown themselves to be the speediest of all during the past year. The "Pioneer," which made the greatest speed in the international race for the Harmsworth Trophy last August, was a Fauber hydroplane, and it is probable that a number of similar craft will be built to defend the cup this year in the two or more races that are now required instead of but one.

As for small, light craft, these were well represented by motor dories and canoes. Some of the tiniest and lightest motors on exhibition were intended for the latter craft. Other light yet powerful motors, chiefly of the two-cycle type, were intended for aeroplanes or racing motor boats. One of these having six 5 by 5 cylinders cast *en bloc* has made a record of 36.1 miles an hour on a 26-foot displacement hull, and besides winning many victories on water, has also propelled aeroplanes with success. In addition to novel features in the shape of "fourth ports" on several of the best engines, one two-cycle motor was noted with a rotary valve for admitting the charge to the crank case. This form of valve, which was invented and applied successfully some eight years ago to a 4-cycle double-acting motor of novel design by James W. Tygard, has been adopted of late by a number of automobile-engine makers abroad, and 4-cycle engines fitted with it were the feature of the last Paris show. Mr. Tygard exhibited a new rotary steam engine, which was shown suspended and in operation, and which could be reversed when running at high speed, with marvelous rapidity and without shock.

Several very large heavy-duty gasoline engines were shown, though not as many as heretofore. The majority of the engines were of the light-weight, or medium-duty size, chiefly of the 2-cycle type. A double-acting motor of this type was one of the features of the show. A boat is to be built for the international race equipped with one of 250 horse-power. One or two makes of kerosene oil engines were also on exhibition.

The novelties at the show consisted of a Curtiss biplane and two 8-cylinder Curtiss motors—one being the motor used in his flight down the Hudson last May—and a model of the 50-foot cruiser in which Capt. John Weller and crew of six intend to cross the Atlantic Ocean next July. The 8-cylinder 37-horse-power automatic engine to be used was shown beside the model. A government non-sinkable motor lifeboat was also a feature of interest.

Perhaps the greatest novelty was a hydro-aeroplane known as the "Flying Fish" and exhibited by a boat-building company of Detroit. In a small scow-like hull having a single narrow hydroplane six inches below it at its center, was placed an 8-cylinder V-type engine of 40 to 50 horse-power. This drove by means of sprockets and chain, a six-foot propeller mounted in front of and below a monoplane surface placed about five feet above the hull. A tail resembling that of Santos Dumont's "Demoiselle" was rigged at the rear.

A great deal of attention has been paid to lighting and ignition outfits for motor boats, the result being that one can now obtain dry cells in hermetically sealed cases and magnetos that are waterproof. A timer and distributor having several decided improvements, and which is intended to be used with dry batteries, was one of the noteworthy accessories. An absorbent pad that can be dropped into the gasoline tank, and which will absorb all the water that settles in the bottom, was another novelty. Electric lighting outfits of all sizes were also on exhibition. On the whole, the show was an excellent preface to the Sportsman's Show which follows.

How Sugar is Tested

Polarized Light and the Saccharimeter

By Joseph B. Baker

THE NECESSITY OF A SPECIAL TEST METHOD.

RAW sugar, as it is delivered to the refiners, is a product of very variable quality and corresponding market value. The quality of a given lot, as it reaches the factory of the refiner or the docks of a port of entry, is not accurately determined by the physical appearance or taste, but by examining a sample in an optical instrument, by polarized light, inasmuch as sugar solutions, in common with certain other substances, possess the property of rotating the plane of polarization of a beam of polarized light, passed through a column of the solution, to the right or left.

THE FORMER METHOD OF TESTING.

The property of solutions of ordinary commercial sugars, of rotating the plane of polarization to the right —the extent of such rotation being determined by the percentage of crystallizable matter (sucrose) and substantially unaffected by the mere color of the solution —was employed in sugar testing prior to 1870. But polarimetry was not made mandatory in the United States, for the duties imposed by the Treasury Department, until 1883. The method of testing that had been in use was known as the Dutch standard method, and was based on a comparison of the color of the sugar under test, by eye, with the colors of a range of sugars of known percentages of sucrose. The range of standards was made up of a group or row of twenty bottles, filled with the different sugars and numbered from 1 to 20, number 1 being the darkest obtainable sugar, perhaps a sample of melada from the East Indies, and number 20 being the finest washed-white refined sugar. The observer filled a similar bottle with a solution of the sugar to be tested, and matched its color with that of one of the standard bottles, assigning it a number corresponding. In practice, Nos. 7 to 16 of the Dutch standards constituted the effective range of the color-matching scale; the darker sugars from 1 to 6, inclusive, and the lighter ones from 17 to 20, inclusive, being too nearly alike in shade to be distinguished with certainty.

This method was sufficiently accurate, but its applicability was destroyed by changes in the methods of manufacturing sugar—among others the introduction of the vacuum-pan process and the production of centrifugal sugars—whereby the color of the product no longer served to indicate its quality. It became the practice to color high-grade sugars artificially, using caramel (burnt sugar), and the Dutch standard method admitted such disguised sugars at a lower duty than their sucrose content, and therefore their market value, logically called for.

POLARIZED LIGHT.

When a beam of ordinary light is reflected from the surface of a sheet of glass it becomes "plane polarized." The same thing occurs when the beam of light is allowed to pass through a "Nicol prism," made from a crystal of Iceland spar. According to the undulatory theory, a train of light waves is propagated through the ether by displacements at right angles to the direction of the beam, and these displacements may be resolved into two components at right angles to each other and to the direction of propagation. In a beam of plane polarized light, one of these two components is suppressed, so that the wave motion is in a fixed plane passing through the line of propagation, or optical axis, instead of in all the planes that include that axis.

A Nicol prism used to polarize a beam of light in a polarization apparatus is called a "polarizer." A second Nicol, called an "analyzer," placed in line with the polarized beam, serves to indicate the angular position of the plane of polarization by extinguishing the beam when turned into a certain position about the optic axis of the two Nicols.

THE SACCHARIMETER.

The polariscope is constructed with Nicol prisms, and with plates and wedges of quartz which serve to impart right-hand and left-hand rotation to the beam of polarized light to compensate for the rotation due to the substance being tested in the instrument. The form of polariscope employed for testing sugars is called a saccharimeter, and its general construction may be described as follows:

The saccharimeter is a horizontal tubular instrument mounted on a stand and fitted as indicated in diagrammatic section in Fig. 1, with telescope eye-piece *T*, Nicol-prism polarizer *P*, and analyzer *A*, double-quartz plate *Q* made up of two halves giving right-hand and left-hand rotation, respectively, and a plate of right-hand quartz Q_2, the rotation of which is neutralized by a pair of wedges Q_1 of left-hand quartz arranged to slide past each other to give a variable thickness of this material in the path of the beam. A tube *S* of standard length between its sealed glass ends and containing the sugar solution of definite strength is slipped into place in the saccharimeter, with its axis coinciding with the optic axis of the instrument. The amount of rotation (left or right) of the sugar solution being additive to or subtractive from the right-hand rotation of the plate of right-hand quartz, is compensated for by sliding one of the wedges of left-hand quartz past the other by a rack and pinion adjustment connected to a milled head, the point of compensation being observed through the eye piece by the depth of the shade of the transmitted light, and the position of the wedges being indicated on a scale which may be calibrated direct in percentages of sugar value in the solution under test, and which is read by means of a separate eye piece or "reading tube" adjacent to the main eye piece of the instrument.

METHOD OF USING THE SACCHARIMETER.

In the actual procedure of testing sugar by the saccharimeter, the sugar is weighed out and dissolved in about 50 cubic centimeters of water. The solution is then clarified by lead acetate solution, made up to standard volume, 100 cubic centimeters, in a calibrated flask, and filtered. The observation tube (200 millimeters long, having screw caps and glass disks at each end, sealed by soft-rubber washers) is then filled and put into the saccharimeter, the illumination regulated, and the reading made. Considerable manipulative care is exercised in making the solution up to standard volume, and also in filling the polariscope tube so that the space is just filled without the causing of pressure on the disks when the caps are screwed on.

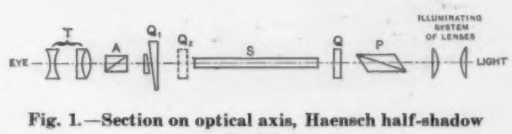


Fig. 1.—Section on optical axis, Haensch half-shadow saccharimeter.

The source of light is preferably an incandescent gas-mantle lamp, placed about 200 millimeters from the end of the instrument; and it is important to screen the eye of the observer from extraneous light, as by an opaque shield with the saccharimeter tube passing through the middle at right angles. In making a reading, the telescope eye piece is adjusted to give the proper focus. The field perceived may show as a round, luminous disk divided into two halves by a vertical line passing through the center, one half of the disk being darker than the other. Rotating the milled head connected to the quartz wedges, to make a setting of the instrument, changes the appearance of the field, the half hitherto dark becoming lighter and *vice versa*. The wedges are adjusted till both halves of the field appear of the same luminous intensity, as indicated by the middle figure of the accompanying drawing, Fig. 2. When this equal illumination has been obtained the eye of the observer is applied to the other or reading tube of the instrument (not indicated in the drawing, Fig. 1), through which the setting of the wedges is read, giving the percentage of crystallizable matter, or pure sugar, directly.

Fig. 2.—Three appearances of saccharimeter field.

When compensated for rotation of double quartz (middle figure) and uncompensated (right- and left-hand figures).

The observer at the saccharimeter reads a number of tubes in succession; but adjusts the zero of his compensating wedge before making the first test by a thumb nut at the wedges, obtaining his matching of the double-quartz field with no optically active substance in the instrument, but with the rotation of the wedges neutralized by the right-hand rotation of a quartz "control plate." The scale proper is attached to the wedge which is moved by the milled head, and attached to the other wedge is a vernier. On each side of the zero line of the vernier a space corresponding to nine divisions of the movable scale is divided into ten equal parts; a device by which the fractional part of a degree of rotation of plane of polarization, indicated by the position of the zero line, is ascertained in tenths.

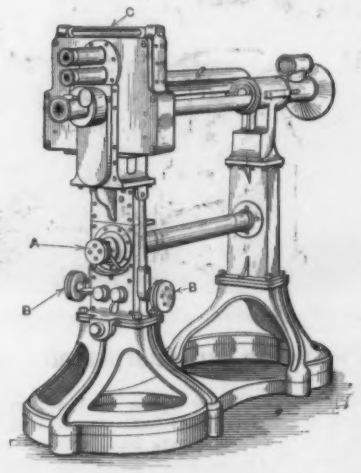


Fig. 3.—The Bates quartz compensating polariscope or saccharimeter.

THE LATEST FORM OF TESTING INSTRUMENT

THE BATES SACCHARIMETER.

The saccharimeter or "quartz compensating polariscope with adjustable sensibility" of Dr. Frederick Bates of the Government Bureau of Standards* is an improved instrument which has been adopted by the United States government for the examination of sugar at the various ports of entry, and by the Department of Agriculture. This instrument (Fig. 3) is the first wedge-compensation polariscope for white light having sensibility and brightness adjustable, thereby allowing plenty of light to be used to facilitate the reading of very dark solutions and at the same time allowing an accuracy of 0.01 per cent in testing the better grades of sugars; there being no shift of the zero point, no matter how much the sensibility of the instrument is varied.

This saccharimeter is based on the Lippich polarizing system, in which the polarizing angle is formed by two beams of plane polarized light coming from two separate Nicols, one of which covers but half the aperture of a larger Nicol. The adjustable sensibility feature is attained by a simple mechanism which acts to maintain the polarization plane of the analyzing Nicol at right angles to the plane bisecting the polarization angle (commonly denoted by α), i. e., the angle between the two planes in which the light from the polarizing Nicols is polarized in the two halves of the field. When this condition is fulfilled, the error for any value of α is within the limit of accuracy of ordinary polarimetry. Referring to Fig. 3 the analyzing Nicol and the large Nicol of the polarizing system are mounted in bearings and driven by gears from a common connecting-rod. By turning a milled head, *A*, fast on this connecting-rod, to rotate the two Nicols, the analyzing Nicol always receives one-half the angular displacement of the large Nicol of the polarizing system. Around the milled head is a circular scale which shows the polarizing angle for any position of the Nicols.

Other features of improvement in the instrument are the location of the milled heads which move the quartz wedges of the compensator in a position (*B*, in the illustration) which permits the arm of the observer to rest free while making a setting. The wedges can be clamped rigid, instantly, at any part of the scale. The scales on the quartz wedges are of ground glass, and are read by transmitted light so that the scale divisions are very clear and there is no black dividing line between a scale and its vernier. A thermometer, *C*, reading from 10 to 40 deg. C. in one-fifth degrees, is placed in a brass case on top of the metal box containing the compensator. The tube of this thermometer is horizontal, but its bulb is placed between the two wedges so that a reading for making correction for temperature of the wedges is readily obtained. Another minor improvement is in making the base of the instrument heavy and mounting it on rubber tips. The resulting inertia of the instrument and friction on its supporting bench preventing accidental shifting with reference to the light source.

Thanks to the feature of adjustable sensibility, with the instrument in adjustment for a polarization angle of 10 deg., for example, the observer can instantly adjust so as to have enough light to make a reading with the darkest sugars (with corresponding low sensibility, suitable for such grades) or he can adjust for testing high-grade sugars with a sensibility exceeding that of any ordinary saccharimeter. In measuring rotations with the greatest possible accuracy, or when it is desired to make the settings with the least possible strain upon the eye, the observer has only to change the polarization angle until he has just sufficient light to match the two halves of the field; and he then has for his eye an instrument so adjusted as to give the maximum sensibility for making the setting, no matter what the character of the substance the rotation of which is being measured.

OTHER SUBSTANCES TESTED BY POLARIMETRY.

Many other substances besides sugars are optically active and are therefore tested by polarimetry, specially adapted forms of the polariscope being employed. Among these substances are oils, camphor, and certain chemical salts. The polariscope test also serves to distinguish certain substances of natural origin from substances made synthetically to compete with them in price. An example is methyl salicylate, which when synthetically prepared has the characteristic odor and the identical chemical composition of oil of wintergreen.

* Described in reprint No. 86 of Bulletin of the Bureau of Standards, vol. 4, No. 3, 1908.

A Laboratory of Therapeutical Chemistry

IT has been decided to install a laboratory at the Pasteur Institute at Paris to be devoted to research in therapeutical chemistry. It will be under the direction of Prof. E. Fourneau, a scientist of considerable note, who has been occupied with experimental work for a number of years past. His discovery of stovaine in 1904, which is a local anæsthetic of great value, attracted much attention.

Recent Aeronautic Progress

A New German Airship and the Voisin Military Biplane

A Huge Non-rigid Airship

AN airship has just been completed and tested, which, equaling the Zeppelins in size and general arrangement, is built without any stiffening frame. All the weight thus saved is put into additional propelling power, and as the airship has very nearly as slight a drag from its rigging as a rigid Zeppelin, and a total of 500 horse-power as against 160 of the "Zeppelin I.," it should show phenomenal speed. Its large size—120 meters (393.7 feet) length, 13 meters (42.65 feet) beam, and 13,500 cubic meters (476,739 cubic feet) displacement—makes necessary a slender-shaped envelope (like that used in the big new Lebaudy non-rigid dirigible "Morning Post"), because even the natural static pressure of the gas against the back of the envelope, due to the greater "head" of gas that results from a larger beam, acts like a stiffening backbone. The "Krell I" is best described as a "non-rigid Zeppelin." She takes her name from her designer, the director of the Siemens-Schuckert works in Berlin. The ship was building for two years and the envelope had at one time to be completely reconstructed after weakness had developed.

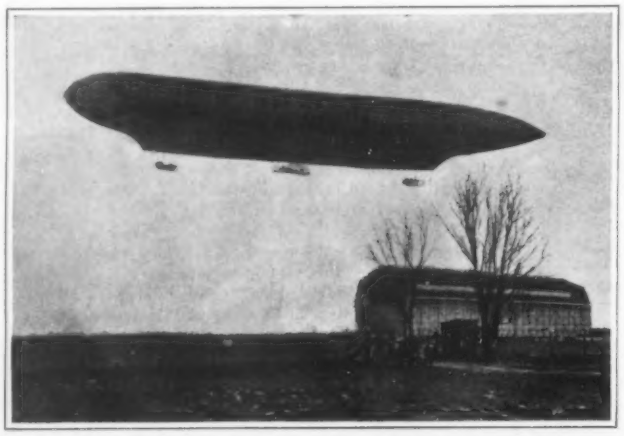
The "Krell I" shows clearly how much strength a Zeppelin derives from the mere pressure of the gas—quite apart from the rigidity of its frame. There is the same long passageway of triangular cross-section running almost the whole length of the ship under the hull, but in this case it is made of cloth without any stanchions, the only rigid part being the flooring. Yet it feels hardly less solid, and not only provides communication between the cars, but also houses the water ballast tanks and fuel and oil tanks, helping to distribute the load over the ship's entire length. The three cars differ from those of the "Deutschland" (counting the passenger cabin as a car) only in that the "captain's bridge" has been moved from the forward car to the center car, and thus space has been gained to carry two motors in the front car as well as in the rear one. However, the propellers being mounted on the cars and not on the flexible hull, and there being no long transmissions, more propellers can be provided. There are three at each car, or six altogether. In each of the engine cars, one 125-horse-power motor drives two two-bladed propellers, mounted on outriggers on the side, and the other motor of the same power drives one four-bladed screw mounted directly on the elongated motor shaft behind each car; that is, supported by a "pyramid" of steel tubes.

The two engine cars are so far apart that no appreciable interference seems to result from this simple and happy arrangement, especially as the center car is—also following Zeppelin's practice—raised to the level of the outer ones.

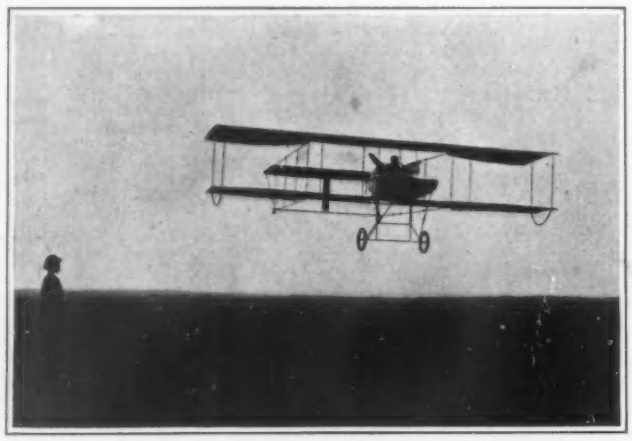
In a flexible airship of such size the air-blowing blowers for maintaining the air pressure in the *ballonettes* are quite large. The center car has been set apart for these, and there are two motors, each of 25 horse-power, to drive them. One motor only is used, the other remaining in reserve. The cars are only slightly lower under the passageway than in the "Deutschland." The short suspension ropes are fastened to the cloth of the passageway. But several auxiliary ropes are led up directly to the envelope, to which they are attached, after the Parseval practice, with layers of "bands" or "patches" of cloth, sewn to the envelope. Horizontal rudders, copied from those of Zeppelin, but much smaller and mounted on the sides of the passageway, and not directly on the hull, are above the front and the rear car, and there is also a horizontal propeller, mounted under the floor of the center car, to be driven in emergencies by the reserve motor in order to help in enforcing a steady level of flight against the variable lift of the gas. Communication between the motor cars and the passageway is by ladders, exactly as with Zeppelin. The mighty vertical rudder, however, is more or less copied from the "Clement-Bayard II." It is like a Venetian blind with five slats, and is mounted just below the slender, sweet-lined stern by a special tubular framework that is secured to the cloth of the hull with "patches" exactly as the rudder rods are fastened in the Parsevals. The cars are also surrounded by a frame resembling the bars of a cage. The shape of the hull is like that of a Parseval, but elongated until it resembles a Zeppelin, blunt in front and sharp in the rear. The "Krell I" seems a craft of wonderful possibilities. It has made so far a couple of short and cautious though successful ascensions. The first trips were made without any stabilizing planes in the rear, as there was then no intention of running at high speed, and the stabilizers could be dispensed with.

The Military Voisin Biplane

THE Voisin Brothers have lately brought out a new light-weight biplane intended primarily for military use, in which the front horizontal rudder, or elevator, has been dispensed with, and the seats for two men have been located side by side in the covered forwardly-projecting body that has been used on all Voisin machines.



The new "Krell I." airship of the Siemens-Schuckert non-rigid type.



Marchal flying with hands off the control wheel.

Side view of prow, showing duplicate control wheels.

A NEW AIRSHIP AND A FRENCH BIPLANE

The dimensions of this new biplane are 11 meters (36.08 feet) spread, 10.5 meters (33.44 feet) over all length, and 38 square meters (409.03 square feet) total supporting surface. With the Gnome motor, the weight complete is 400 kilograms (881.84 pounds).

The parallel planes, of equal length, are 6½ feet in width. Attached to the rear edge at the outer ends of the uppermost plane are two very large hinged flaps, or ailerons. These taper and diminish very perceptibly in width from their center point to their ends toward the center of the machine, the inner ends being about half the width of the outer ends. The uprights separating the main planes, as well as the body frame and the wide framework extending back of the main planes and supporting the tail, are made of nickel steel tubing, which gives great strength and permits of the rapid taking down or assembling of the machine. This tubing is elliptical in shape, which gives the minimum air resistance.

The aeroplane is mounted on two pneumatic-tired wire wheels, located below it on telescopic tubes having coiled wire springs to take up the shock in alighting. Forwardly-inclined tubes running almost to the front end of the body brace this chassis in a suitable manner. At each end of the lower plane are semi-circular skids to take the shock in case the machine tips when alighting. Tiny skids of similar shape are placed at the rear end of the frame that supports the tail. This is a single surface affair, located above the single vertical rudder at the top and extreme end of the rearwardly-projecting framework. Inclined braces from the bottom of the frame hold the rear edge of the tail rigid, so that the horizontal rudder can pivot about it. This rudder consists of a hinged flap with operating wires running from a vertical lever attached to its front edge. The wires connect with the duplicate control wheels in the body at the front. A forward-and-backward movement of the control wheels, which are attached to posts pivoted at their bottom ends, operates the horizontal rudder. By turning the wheels, the aviators can work the single vertical rudder, while by pushing pedals, they can pull down on the ailerons, or hinged flaps, in case the machine tips to one side or the other.

In addition to placing the seats for the aviators well in advance of the planes, the designers of this new biplane have moved the Gnome motor forward to a position above the center of the lower plane. This has made necessary the use of a separate shaft extending back from the motor to the two-bladed aluminium propeller. The Voisins have used such a propeller from the start, and they still believe it preferable to one of wood. The blades of laminated aluminium are pressed and riveted to steel tubes which work in a slotted hub in such a way that the angle of the blades, and consequently the pitch of the propeller, can be varied while in flight.

On account of the arrangement of the seats and duplicate control wheels, the new Voisin machine has been found an excellent one for the teaching of pupils. It has been found possible to instruct a tyro so that he can make satisfactory flights, including turns, after but five lessons. That the machine has a considerable degree of inherent stability can be seen from the photograph which shows M. Anselme Marchal flying with his hands off the control wheel and raised in the air. The new machine can also take the air after a run of but 175 feet along the ground, whereupon it will rise in the air at an angle of 30 degrees, while carrying a normal load of 250 kilograms (551.15 pounds) of useful weight, or under a loading of 3½ pounds per square foot. The maximum load that can be carried is considerably greater than this. On account of its considerable weight-carrying ability, this new Voisin biplane can be used for bomb dropping, or for the carrying of passengers. The moving of the center of gravity of the machine so far forward has taken practically all weight off the tail. As a consequence this is practically flat and set, if anything, at a negative angle when the machine is in flight.

The chief advantage of the steel tube construction is that the machine can readily be dismounted and packed in two boxes of 176.5 and 317.8 cubic feet capacity. The time required to reassemble it is not more than a couple of hours.

In connection with the problem of automatic stability, it is interesting to note that Lieut. Dunne, of England, has succeeded in obtaining such excellent fore-and-aft stability with his peculiar V-shaped biplane that he has flown in circles for several minutes, and made notes with a lead pencil while in flight. The new Antoinette monoplane, also, is fitted with a weighted horizontal rudder which keeps the machine on a level course when in flight, without the pilot having to steer it. Thus it can be seen that considerable progress is being made in the direction of an automatically stable aeroplane.

FRANK PAINE, a chaffeur who has recently built a Curtiss-type biplane and made a number of short flights at Mineola, while practising at Bridgeport, Conn., for an exhibition flight, met with a serious accident on March 3rd. He was flying at Seaside Park, above the shore of Long Island Sound, and after making a successful flight of about half a mile at a height of 50 feet, the machine suddenly dove to the ground and was demolished. Mr. Paine received injuries that may be fatal. His accident should serve as a warning to all new aviators—especially those who build their own machines—not to attempt flights over dangerous ground before they have had suitable practice over a proper aerodrome.

The Heavens in March

Our Monthly Astronomical Page

By Henry Norris Russell, Ph.D.

THE problems with which modern astronomy has to deal are as varied as the heavenly bodies. For the last two months we have discussed recent advances in the knowledge of certain stellar systems. At this time it may be of interest to turn to quite a different problem, that of the origin of comets, of which a very interesting discussion has recently been given by Prof. Strömgren, of Copenhagen.

The point at issue is: Are the comets members of our solar system or visitors from outer space? Certain comets, such as Halley's, which move in elliptical orbits and return to the sun at definite intervals, obviously belong to the former class. But for the majority of comets the situation is less obvious. It must be remembered that a comet may move in any one of three kinds of orbit; an ellipse, perhaps very long and narrow, but closed and returning to the sun; a parabola, whose branches along which the comet approaches or recedes, become ever more nearly parallel, but never actually meet; or a hyperbola, whose branches diverge even more widely, like two lines drawn in different directions. In the first case the comet will return to the sun; in the others it will never do so.

The second or parabolic form of orbit is a transition between the other two.

Now, most comets move in orbits very near this transitional form, so that long and accurate series of observations, and careful calculations, are necessary to tell whether they may be expected to return to the sun, after thousands of years, or to go off into space and leave us forever. This is not the worst of it. The planets are forever attracting the comet, and by their influence modify its orbit. When a comet moving in a parabolic orbit passes near a planet (especially the massive Jupiter) its attraction may tend to slow its motion. In this case the orbit will become an ellipse, and the comet will return at regular intervals (unless, indeed, another encounter with a planet changes its orbit). If, on the other hand, the comet's motion is accelerated, it will pass off in a hyperbolic path, never to return.

Of the comets whose orbits have been accurately calculated, the majority move in long ellipses, but a few in orbits distinctly hyperbolic. The question then arises: Have the elliptical orbits been produced by the retarding action of planetary attraction on comets which originally approached our system in hyperbolas, from without, or is the reverse true, and are the few observed hyperbolic orbits the results of acceleration of the motion of comets whose path would otherwise have been elliptical?

It might seem as if the fact that the majority of the comets observed move in ellipses showed that such orbits really predominate; but this neglects the circumstance that an elliptic comet, returning regularly, will be counted repeatedly, but a hyperbolic comet only once. The question can really be answered only by detailed and laborious calculation in each individual case.

Such computations for all the comets which, when nearest the sun, moved in distinctly hyperbolic orbits, have been made by Strömgren, and independently by the French astronomer Fayet. In every case it has been found that the comet was originally moving in an elliptic path (or differed from one by less than the inevitable uncertainty of the observations). That is, all known comets, so far as investigated, are in all probability members of our solar system, and when we observe them, are returning visitors to the sun.

There is not a single demonstrable example of a comet's entering our system from without.

Some of the comets may recede to distances exceeding Neptune's a thousand-fold, and their returns may be millions of years apart; but, even so, they reach one-tenth the distance of the nearest star, and, from that wider standpoint, obviously belong to the sun's domain.

The apparently exceptional cases are those when we observe a comet in process of loss to the system to which it previously belonged, fleeing away into space by a conspiracy of planetary and solar attractions, and lost to us forever. There is, of course, some small chance that such a comet may pass near some other system, and be captured there, and also that one system should pick up some such outcast from another family; but the interplanetary spaces are so small, in comparison with the vaster void which surrounds them, that it is no wonder that no such visitor has passed within our range in the few centuries during which the heavens have been studied well enough to enable us to distinguish it if it came.

THE HEAVENS.

Turning to our map, we find the twins Castor and Pollux almost overhead. To the west and southwest are the familiar forms of Taurus, Orion and Canis Major.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9 o'clock: Mar. 6.
At 8½ o'clock: Mar. 16.
At 8 o'clock: Mar. 23.

At 9½ o'clock: March 1.

NIGHT SKY: FEBRUARY AND MARCH

Far in the south, only partly above our horizon, is the vast southern constellation Argo, the ship which bore Jason and his comrades on one of the most romantic adventures of classical story. This constellation, so unfavorably placed for our study, is the largest in the heavens, containing 133 stars visible to the naked eye (Draco following with 80). Indeed, it is so big that, to facilitate reference to stars within it, it has been divided into three parts—Puppis, the stem; Carina, the keel, and Vela, the sails; whose relative positions may be seen in our initial. Huge as it is, it represents but half the ship, the prow being missing, as the corresponding space is occupied by parts of the Centaur and the Southern Cross.

Its brightest star, Canopus, lies but 37½ deg. from the south pole of the heavens, and its greatest altitude (in degrees) above the southern horizon, may be found by subtracting the observer's latitude from this number. It is hardly visible at all in Virginia, and can be seen well clear of the horizon only in the States bordering on the Gulf or on our southern boundary. There can be no difficulty about identifying it as it is second only to Sirius, and twice as bright as any other star in the heavens. It is almost due south of Sirius, and can best be seen about half an hour before the latter crosses the meridian.

In the southeast we now see more than half the ungainly length of Hydra, and Corvus and Virgo are rising. Leo is well up in the east, Bootes is on the northeastern horizon, and between the two is the diffuse star-cluster of Berenice's Hair. The Great Bear is high in the northeast. Draco and Ursa Minor are on the right of the pole, and Cepheus and Cassiopeia on the left, Andromeda and Aries are setting in the northwest and west with Perseus above them, and Aurega still higher.

Saturn, very low in the west, is the only planet visible to the unaided eye.

THE PLANETS.

Mercury is morning star until the 20th, and evening star afterward. He may perhaps be seen in the twilight during the first few days of the month, but later will be invisible.

Venus is splendid as the evening star, and is increasingly conspicuous, setting at 7:38 on the 1st, but not till 8:45 on the 31st.

Mars is morning star in Capricornus, rising about 4 A. M. on the 15th.

Jupiter is in Libra, and rises at 11 P. M. on the 1st and 9 P. M. on the 31st. On the 27th he is a little over 1 deg. north of the wide double star Alpha Librae, forming a very pretty group for a field glass, or better, a small telescope. Saturn is evening star in Aries, setting at about 10 P. M. at the beginning of the month, and 8:15 P. M. at its close. He is in conjunction with Venus on the 29th, not very close by.

Uranus is morning star. On the 11th he is in conjunction with Mars, being 24 min. north of him. If the planets were only visible at a convenient hour of the night, this would be a very good time to find the fainter of the two.

Neptune is in Gemini, visible telescopically all through the evening.

The moon is in her first quarter at 6 P. M. on the 7th, full at 7 P. M. on the 14th, in her last quarter at the same hour on the 22d, and new at 7 A. M. on the 30th. She is nearest us on the 6th, and farthest away on the 21st.

In her circuit of the heavens she passes Venus on the 2d, Saturn on the 5th, Neptune on the 10th, Jupiter on the 19th, Mars on the 24th, Uranus on the 25th, and Mercury on the 26th.

At 1 P. M. on the 21st, the sun crosses the celestial equator, passing through the vernal equinox, and, in the language of the almanacs, "Spring commences."

Current Supplement

IN an article entitled "Cellulose," which opens the current SUPPLEMENT, No. 1836, Mr. Carl G. Schwalbe discusses one of the most misunderstood substances in the world, and gives a vast amount of information of a most interesting kind—Frank C. Perkins contributes an illustrated article on modern German police call and fire alarm systems.—If the manufacturer has any doubt of the value of illuminating engineering to him, he has but to read an article on that subject by Mr. V. R. Lansingh.—A remarkable Spanish mining concrete pier is described and illustrated.—Mr. George J. Jones writes instructively on blue-printing by machinery.—A nation that spends as much every year for electricity as it does for bread may well entertain sentiments of reverence toward its pioneers in the electrical arts. One of these is Thomas Davenport, of whom Mr. T. Commerford Martin writes appreciatively.—During the last few years the researches of eminent astronomers have thrown a flood of light upon some of the most recondite problems. These are treated by Mr. F. W. Henckel under the heading "New Methods of Astronomy." Although astronomy from the earliest times has been enthusiastically studied, very few know anything definite about the nature and methods of work at an observatory. These Mr. C. H. Gingrich tells about in an article entitled "The Determination of Standard Time."

ACCORDING to a recent press dispatch, the wireless telegraph station at the Eiffel Tower is nearing completion, and it is hoped that direct communication can be established by this means between Paris and New York and Canada. Already messages have been transmitted from Paris to Tunis and other points in Africa.

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

Nebulae

NEBULAE play a prominent part in modern theories of cosmogony. Some regions of the sky are almost filled with nebulæ, while in other regions most of the stars are crowded together in a relatively small space. In some parts of the Milky Way more than 100,000 stars have been photographed in an area one degree square. The millions of stars of our universe appear to form a well ordered and stable system, whose laws and motions, however, are unknown to us. Certain classes of nebulæ show a tendency to avoid the Milky Way.

The most perfect photographs of the sky that we possess, such as the splendid plates made by Keeler and Ritchey in America, and by Wolf of Heidelberg, show a background of thin haze which in places is condensed into distinct nebulæ. These photographs also show that nebulæ of a certain type assemble in regions remote from the Milky Way and cluster most thickly round its poles. The Swedish physicist Arrhenius has recently given a very plausible explanation of this peculiar arrangement. It is now regarded as proved that the sun possesses, in addition to its attraction, a repulsive force, which is exerted by means of the solar radiation and is called radiation pressure. This pressure is proportional to the surface exposed to radiation, while the attractive force is proportional to the mass of the attracted body. For very minute particles of matter, therefore, the repulsion exceeds the attraction, and such particles are repelled from the sun. The tails of comets, which are always directed away from the sun, are believed to be streams of such particles detached from the head and driven away by radiation pressure. The multitude of fixed stars must exert a similar radiation pressure on nebular matter and cosmical dust, and consequently this matter is repelled from the plane of the Milky Way, where stars are thickest, and accumulates in nebulæ at the poles of the Milky Way, where there are few stars.

When Herschel was continually increasing the size of his telescopes and, with each increase, resolving more nebulæ into clusters of distinct stars, it was assumed that all nebulæ were really star clusters, and would be resolved with the still more powerful instruments of the future. The spectroscope, however, dispelled this idea.

Sir William Huggins, the recently deceased pioneer in stellar physics, discovered in 1864 that the spectra of some nebulæ were not continuous, like those of stars and star clusters, but were composed of a few widely separated bright lines. Hence it was inferred that these nebulæ must be masses of incandescent gas.

At present, Prof. Otto Hoffmann writes in *Prometheus*, most stellar physicists are inclined to doubt the possibility of the finely divided matter of the nebulæ being composed of incandescent gases. The cause of the faint light which gives the bright line spectrum is not known with certainty. It may be due to radioactive emanations. According to Scheiner, the collision of two molecules moving with great individual velocities may produce light, accompanied by great elevation of temperature, but the production of such effects in the very sparcely distributed and intensely cold nebular matter is hardly conceivable. The breadth of the great nebula in Orion must be at least four thousand times greater than the distance of the planet Neptune from the sun. As this nebula produces no perceptible effect on the motions of the nearest stars, its mass must be very small. Hence the matter which composes the nebula must be very much less dense than that of any "vacuum" that can be produced in the physical laboratory.

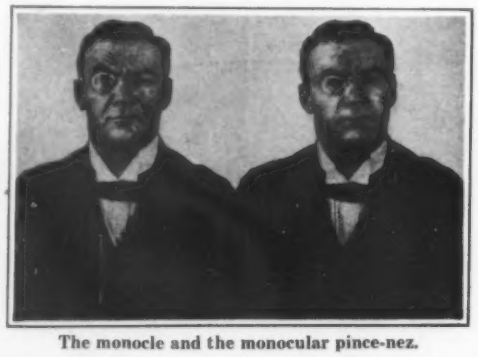
How worlds are built of such exceedingly attenuated matter remains an enigma, like the cause of the nebular light. In those nebulæ that show continuous spectra, like those of the stars, the process of development is more easily comprehended. To this class belong the nebulæ of spiral structure, including the nebula in Andromeda, the most striking in appearance of all nebulæ. According to Prof. Ritchey, the spiral nebulæ contain great numbers of star-like condensations, or nebulous stars, which are possibly stars in process of formation. These are intermingled with streams and patches of nebular matter.

Keeler, who devoted especial attention to this subject, estimated the number of spiral nebulæ at several hundred thousands. These nebulæ exhibit the initial stage of formation of new worlds on a stupendous scale, and have themselves been produced by the destruction of former suns. Prof. Chamberlin explains their spiral structure by the oblique collision of two stars, causing the violent eruption of two streams of matter which assume a spiral form in consequence of the rotation and attraction of the colliding and coalescing masses. Some spiral nebulæ distinctly show these two streams.

For the present, however, all theories of the origin and structure of the universe must be regarded as pure speculation. The most plausible hypothesis is in turn succeeded by another, and no man can predict that the true one will be found.

A Substitute for the Monocle

THE monocle is a venerable institution. The use of spectacles did not become common until near the close of the fifteenth century, but throughout that century a reading lens provided with a long handle was used very generally by elderly persons. This implement was called, at first, a manocle (hand eye-glass), afterward a monocle (single eye-glass). Long after this period ornamental monocles of this type were carried, like the modern double lorgnettes, by ladies and gentlemen of fashion, and employed chiefly to emphasize a haughty stare, and they have recently re-appeared as substitutes for double lorgnettes.



The monocle and the monocular pince-nez.

Eye-glass frames and monocular pince-nez.

The fashion of wearing a monocle held in place by the muscles surrounding the eye is of uncertain origin. Dr. Oppenheimer, whose discussion of the subject in *Die Umschau* forms the basis of this article, concludes that the custom is not many generations old. The ridicule which was cast upon the wearers of spectacles and eyeglasses, before the utility and need of those aids to sight became generally recognized, seems now to be concentrated upon the monocle, and not without reason. The conclusive facial distortion and peculiar appearance of the eye caused by the monocle (Fig. 1, left), and especially the fact that it is used only by members of the "higher classes," and often, obviously, through sheer foppery, have brought the monocle into discredit with the general public.

This result, Dr. Oppenheimer thinks, is greatly to be deplored, for the monocle possesses certain advantages over other eye-glasses and spectacles. Theoretically, indeed, the monocle is the ideal eye-glass, and, if it were possible to wear a monocle in each eye, spectacles and eye-glasses of the *pince-nez* type would be superfluous. The simple monocle costs little, needs no repairs, and, if properly fitted to the eye, is easily kept in the correct position.

The possible applications of the monocle are more numerous than is commonly supposed. For example, a person who for any reason is compelled to wear a bandage over one eye usually finds it difficult or impossible to wear spectacles or double eye-glasses, but a monocle can be worn without difficulty, so that the uninjured eye can be used in reading and writing. Again, there are cases of impaired vision which are greatly benefited by ocular exercise combined with proper refractive correction. When only one eye is thus affected the monocle is very useful. One-eyed patients (and an astonishingly large proportion of humanity is one-eyed in the sense of possessing only one good eye) usually find monocles more convenient than spectacles or double eye-glasses, as the second glass is only an annoyance.

Most, though not all, of the advantages of the simple monocle are possessed, while its defects are avoided, by the monocular *pince-nez*, which is simply an ordinary *pince-nez* with one lens removed. The frame must be so constructed that it will hold the single glass securely in place without the balancing action of the other glass. The American frame, in which the nose is clamped between two plates of metal or horn pressed against its sides, is the most suitable type. A monocular *pince-nez* is illustrated at the bottom of Fig. 2. Its use requires no practice, and produces no distortion and very little change in the appearance of the face, as is evident from the right-hand illustration of Fig. 1.

How and Why Do Leaves Fall?

THE causes of the autumnal leaf-fall are discussed in an interesting review of the present status of this problem of botanical science published in a recent number of *Knowledge* by G. S. Boulger. The author says, in part:

If we look at the question of leaf-fall from the point of view of the systematic botanist, we find that the lower and simpler types of leaves do not fall. The primitive leaves of mosses have no articulation at their base; the elaborately-divided fronds of most tree ferns wither and hang their dead stalks downward from the stem; the needles of conifers wither similarly, generally after being several years on the tree; and the simple sheathing leaves of most Monocotyledons have not so perfect a system of articulation as we find in the Dicotyledons, especially those with compound leaves.

A thoughtless, unobservant conclusion would be that the leaf dies, and consequently then falls off; but this is far from being the case. Preparations may begin for the fall of the leaf almost as soon as it is formed; and in many cases the leaf is moist and its cells fairly inflated when it falls. In 1848 Dr. Inman, in a paper communicated to the Literary and Philosophical Society of Liverpool, described an inward extension of the cork of the bark and disruption taking place through cellular tissue external to this corky layer, from without inwards.

"The provision for the separation," he writes, "being once complete, it requires little to effect it; a desiccation of one side of the leaf stalk, by causing an effort of torsion, will readily break through the small remains of the fibro-vascular bundles; or the increased size of the coming leaf bud will snap them; or, if these causes are not in operation, a gust of wind, a heavy shower, or even the simple weight of the lamina, will be enough to disrupt the small connections and send the suicidal member to its grave. Such is the history of the fall of the leaf. We have found that it is not an accidental occurrence, arising simply from the vicissitudes of temperature and the like, but a regular and vital process, which commences with the first formation of the organ, and is completed only when that is no longer useful; and we cannot help admiring the wonderful provision that heals the wound even before it is absolutely made, and affords a covering from atmospheric changes before the part can be subjected to them."

In 1859 Hugo von Mohl, the illustrious founder of the cell theory, chanced to spend his autumn vacation at home, so that he observed the successive fall of the leaflets and the leaf stalk in the leguminous *Gymnocladus canadensis* with the conveniences of his laboratory at hand. He found that a layer of cork already extended through the cellular tissue at the base of the petiole in September. Immediately above this a layer of cells had become brown (suberized); and, separated from this by two or more rows of the ordinary colorless polyhedral cells of the leaf stalk, what he termed the separating, or "absciss," layer originated. This only formed between

The terminal leaves still remaining on a linden tree.

A beech which has lost the leaves from the ends of the shoots.

Longitudinal section of a stem and base of a leaf stalk of horse chestnut.

THE CAUSE OF FALLING LEAVES

the 4th and the 15th of October, extending across the stalk from the inner or axillary surface, and contained in its cells protoplasm and starch grains. It is, in fact, what we now term "secondary meristem." Von Mohl only recognized two layers of cells in the absciss layer, which he believed to split apart, while he thought that the fibro-vascular bundles were broken mechanically by the weight of the blade and the strain of wind and rain. He perceived, however, that the fall of the leaflets between the 10th and 20th of October, and the subsequent fall of the petioles was independent of the cork layer formed at least a month before. This cork layer, in fact, is not formed in advance in those ferns which are deciduous, in beech, elm or most oaks. Von Mohl also noticed that when leaves fell suddenly, after an autumn frost, a thin layer of ice had formed in the delicate sappy cells of the absciss layer, torn cell walls evidencing the violence of the disruption.

In 1863, Julius Sachs traced the gradual removal of the contents of the leaf cells. The protoplasm and nuclei are dissolved, the chlorophyl granules become disintegrated, the starch disappears, leaving only the few yellow granules, or the reddened cell sap, which produce our autumn tints; while starch, potash and phosphoric acid travel down the leaf stalks to be stored up in the twigs, and only the waste of end products of metabolism, calcium oxalate crystals, resins and alkaloids remain to be thrown off with the falling leaves.

In 1882 MM. Guignard and Van Tieghem returned to the study of *Gymnocladus;* but began their investigation in the middle of June. They found that no cork is formed at the base of the leaflets. It is not worth while to heal the wound on the leaf stalk which is itself to fall in a day or so. The suberized layer was formed at the base of the main petiole by the middle of June; then a layer of meristem, the "phellogen" or cork cambium, originates below it and the abscis layer above it, before the end of June. This layer spreads inwards from the epidermis through the cellular tissue of the bast and wood bundles. It consists not of two, but of three, layers of cells, of which the middle row is absorbed. The two remaining rows, still living and turgid, swell outward with rounded surfaces, and so create a strain which snaps the fibers and vessels. These observers also induced leaf fall artificially at midsummer, by placing a cut branch in a box filled with moist air, and they found that after the fall of the leaf the cellular tissue of the vascular bundles whose ends are exposed on the leaf scar becomes "merismatic," i. e., undergoes cell division, forms cork, and penetrates and fills up the ends of the vessels.

It is well to bear in mind that prolonged drought will induce leaf-fall much as does a frost, and that a layer of cork is formed below the prickles on old stems of rose or bramble, and below twigs in some plants which shed these branches as others shed their leaves. On the other hand, if a branch be broken through early in summer, its leaves wither but do not fall, no abscis layer being formed. Coppiced oaks or the clipped beeches and hornbeams in the hedges of nursery gardens also retain their leaves, as if the energy and material used up in the formation of callus to heal the wounds caused by pruning knife or shears left none for the formation of the usual abscis layers.

Every one must have noticed the successive fall of the leaflets and the leaf stalks in the ash or horse chestnut, the thick-ended petioles being aptly known by children as "bones," since they are by no means unlike the leg-bones of birds. There is, however, another interesting little point in connection with leaf fall which is, perhaps, less familiar, and which is well illustrated in the photographs, by Mr. Johnson, of Tunbridge Wells, from which our pictures have been prepared. This is the order in which the leaves fall from the twig. In the beech this is *basipetal*, i. e., the younger leaves at the apex of the twigs fall first. In the linden, the poplar, and apparently in the majority of trees the fall takes place *acropetally*, i. e., the older leaves at the base of the twigs fall first.

The Universe a Mechanism

THE point of view defined in Herbert Spencer's well-known "formula" forms the starting point and leading thought of an article published by John Candee Dean in *Popular Astronomy*. We have selected for quotation from this paper a number of passages which seem to be of special interest:

"Organic progress consists in change from the homogeneous to the heterogeneous, and the law of organic progress is the law of all progress. It makes no difference whether we examine into the development of society, government, commerce, language, literature, art or the sidereal heavens, the same evolution of the simple into the complex through successive modifications will be found.

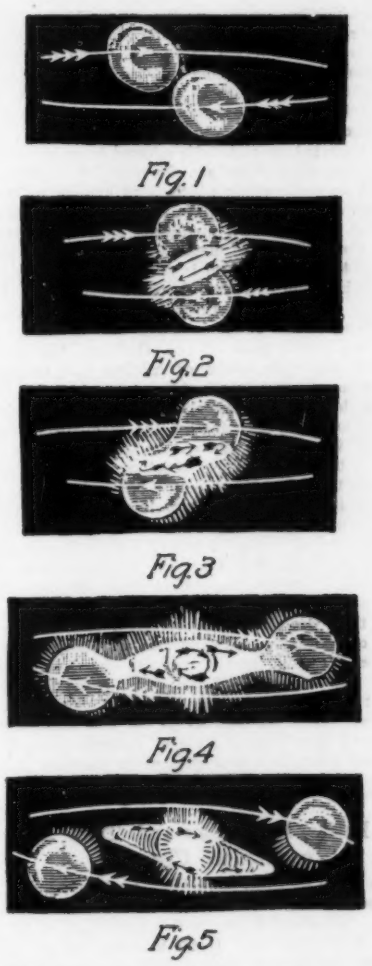
"It is now generally admitted by the informed that all forms of living organisms, including man, have been evolved from primitive forms of life in which there was no break in the continuity of the process. The orderly processes in life, and the structure of animals and plants have developed by mechanical laws, and these powerful natural forces have for millions of years exercised supreme control over the entire course of organic evolution.

"The law of mechanical causality teaches us that every phenomenon has its mechanical cause, and the entire universe, including the minds of man, is ruled by this law. The science of evolution has been carried beyond the planets, beyond the solar system, and into the deepest recesses of the sidereal universe.

"The spectroscope shows that the blinking star Algol, alternately advances toward us and recedes from us at a rate of twenty-six miles a second in a period synchronous with that of its variability. The explanation of the changes in its brightness is found in a binary system in which a dark body smaller than Algol revolves around it in an orbit lying edgewise to us, so that at each revolution Algol is partially eclipsed by the dark star. The discovery of a large number of short period variable stars of the Algol type indicates that black stars are very numerous, and Sir Robert Ball expresses the opinion that they outnumber the lucid stars. These black bodies are dead Suns that have lost their heat energy by radiation and are like clocks that have run down.

"There is evidence that there is a regenerative influence at work in the creation of new nebulæ by the accidental collision of stars. This appears to be Nature's method of preventing the final dissipation of energy which would occur from the gradual cooling of hot bodies and the warming of cool bodies until all matter would be of one temperature. Stellar impact differentiates the temperatures of stars, and thereby prevents all matter from attaining the same thermal level. The mighty machinery of the cosmos is immortal in its workings. Systems are evolved, play their parts on the great stage of the universe, are scattered for a time, only to reappear in new and equally glorious forms. Ceaseless change is the only constant thing in nature. The complete cycle of changes carries matter through all its phases, from the simplicity of matter in the hottest nebula up to the complexity of matter in the planets and in the common Earth.

"When a star suddenly blazes forth in a place where



Cuts showing an impact of two stars or dead suns which results in the formation of a temporary star that expands into a nebula.

Fig. 1.—Pair of stars distorted by mutual attraction and coming into impact. Fig. 2.—Pair of stars in impact. Fig. 3.—Passing out of impact and forming a third body. Fig. 4.—Entanglement of matter before separation. Fig. 5.—A temporary star of very high temperature is formed, which finally expands into a nebula. Drawing by Bickerton.

none had been observed before, the phenomenon is supposed to be the result of a collision between celestial bodies, which may be either bright stars, black stars, or meteoric swarms. There are records of more than twenty new flaming stars, some of which were visible in the daytime. In November, 1572, Tycho observed a star, called the Pilgrim, that suddenly appeared in the constellation of Cassiopeia, and at once became so brilliant that it could be seen at noonday. Such stars are called *Novæ*. Two notable examples of them within recent years are Nova Aurigæ of 1892 and Nova Persei of 1901. The latter was the most brilliant new star that has appeared since 1604. In three days it increased in brightness 25,000 fold, and for a few hours was nearly as bright as Sirius. The writer had the pleasure of observing it when near its most brilliant phase.

"All novæ are temporary, and rapidly fade in nebulæ. Nova Persei, following the usual course, became invisible to the naked eye in six weeks, and its spectrum soon became nebular. So terrific was the heat evolved that the gases expanded outward with a velocity of over 2,000 miles a second. Its distance was so great that its light, traveling with a velocity of 186,000 miles a second, reached us after a period estimated at 300 years, hence the collision must have occurred about the year 1600.

"All visible fixed stars are gaseous suns, and the falling together by gravitation into direct impact of two such bodies would probably evolve insufficient heat to produce a nebula, unless the stars originally had considerable motion; but if the impact is only partial, so as to shear off limited portions from each star, this matter would suddenly flame forth and expand into a gaseous nebula, while the two scarred stars would continue their courses at reduced velocities. Thus partial impact generally results in the birth of a third body of nebulous matter struck off from the meeting stars, and this new star with its momentum destroyed remains behind. If the amount sheared off equals one-third of the mass, then three bodies of equal mass would result. It has been estimated by Bickerton that collisions between stars moving at the rate of 100 miles a second would produce a temperature 100,000 degrees, depending to a certain extent on the elements contained in the colliding bodies. The runaway star shown as 1830 Groombridge, has a motion of about two hundred miles a second.

"It can be shown that stars may explode by near approach without actual impact. There is a well established law that where a body passes within a certain distance of a larger dense body it will be torn into fragments by differential attraction. This is called 'the law of disruptive approach,' and the limit of the distance that the two bodies must approach in order to produce disaster is called the 'Roch Limit.' Spiral nebulæ are supposed to be the result of the near passage of two stars and the consequent explosive ejection of matter forming the two spiral arms containing nuclei at irregular points. Prof. T. C. Chamberlin has shown that the bursting of the smaller body of two stars by near approach is from four to six times as imminent as by actual collision. He also calls attention to the fact that the disruption of a body like the Earth by near approach, where the interior temperature is much above the melting point and greatly compressed within by self-gravity, would cause it to burst forth in a luminous body with perhaps dispersive violence. Prof. Chamberlin further shows how the meeting of a solid with a gaseous body, where there is actual impact, may produce a nebula of the spiral form. He says: 'The effects of explosive projection combined with concurrent rotation must obviously give rise to the spiral form. These should be two chief arms to the resulting spiral starting at opposite points of the central mass and extending outward to the limits of the spiral. The collision of dead suns in which disruption by approach preceded actual impact may play a part in forming irregular nebulæ.'

"No certain statement, as to the age of the Solar System, can be made. Astronomers now speak with less confidence than formerly of the age of the Sun, because of the discovery of the radio-activity of matter has led to the belief that it may play an important part in maintaining the Sun's effective heat. Lockyer says that the sun's spectrum proves that it has reached an advanced stage of development and is now on the decline by cooling. Its density is apparently much greater than stars of the Algol type, which indicates that the Sun has contracted by cooling more than they have, and is therefore on the downward grade.

"To account for the immense number of bright stars, some effective means of regeneration must be postulated. No matter what time we may assume for the length of life of a star like our Sun, the whole previous history of the sidereal system must have been comparatively brief to account for its present status, without some process of renewal. By the clashing of suns the first mists called nebulæ are evolved, which condense into brilliant stars and organized systems. The wreckage of dead suns rekindles the heat of matter and gives perpetuity to the cosmic system. Unless there is some process of rejuvenation, all bright stars would slowly lose their heat energy, fade to darkness and finally reach the temperature of interstellar space, supposed to be about 300 degrees below the zero of Fahrenheit. The fact that the stellar universe has not attained a state of black refrigeration is conclusive proof of the existence of some process of renewal. The general conception of evolution is antagonistic to creation. The creation of matter is unthinkable, because the human mind cannot conceive of *nothing* becoming an object of consciousness. There is no evidence of creation, or even a beginning of the cosmic system, nor is there promise of an end, the present is but a phase of an endless cycle in an immortal universe.

"Recent researches regarding the theory of Laplace indicate that some of its details will require modification, especially those relating to the formation of planets from rings detached from the central mass of a nebula. Several astronomers now support a theory that the solar system was evolved from nebula of the *spiral* form, notably Professors Chamberlin, Moulton, and See. The number of spiral nebulæ within range of the telescope is estimated at about 120,000, all of which may be embryo solar systems. Among the best known are the spiral nebula of Andromeda, the Great Bear, the Lion, Pegasus, Virgo and Canes Venatici.

"Professor See has in press a work on the 'Evolution of the Stellar Systems,' in which he presents his latest views on the spiral nebula hypothesis. He endeavors to prove that the solar system was evolved from a spiral nebula in which the matter now forming the planets was not detached from the Sun, but was accreted from its spiral arms. According to Prof. See's view, the satellites were captured by the planets and not detached from the bodies around which they revolve. The Moon was originally a planet revolving around the Sun which on nearing the Earth was captured by gravitation, and has since remained a prisoner of the Earth.

"In applying this theory to distant nebulæ we must remember that during the time that the spirals of a nebula are supplying materials for the formation of planets, the nucleus is condensing into a sun, and after the evolution

of the planetary system the most powerful telescope would only reveal the central sun as a fixed star, the planets being too small, and their reflected light too weak to be seen.

"Ether waves were sent out by the Marconi system to carry messages over the sea. Ether waves sent out by the stars bring messages to every part of the world. The stellar receiving instrument employed is called the spectroscope. The wit of man has never devised a more wonderful instrument that this receiver. The messages are not in the Morse code, but come in the beautiful cipher of Nature, illuminated with lovely prismatic colors. When the telescope of the spectroscope has been trained on a distant star, what information does the wireless message convey to the skilled spectroscopist? It informs him as to whether the star is single or double. If double, and the two stars are physically connected, it discloses their velocity of motion in line of sight, and tells the period of revolution of short period binaries around their common center of gravity, and affords information as to the mutual distance and masses of the components. If the star is single and its motion rapid the message tells whether it is approaching or receding from us and reveals its radial velocity in miles per second. It tells its chemical composition and gives the elements as accurately as could be determined from a sample of the star in a laboratory. It further shows the approximate temperature of the star and imparts information as to many other things that cannot be entered into here.

"In discussing the collision of stars it was stated that the resultant temperature from impact might reach 100,000 deg. F. The highest temperature that has ever been artificially produced is that in the narrow focus of the electric arc, estimated at 6,000 degrees, which is far below the temperature of the coldest visible fixed star. The stars of the heavens have been found to be gigantic furnaces with temperatures enormously higher than any of which the chemist had dreamed. The fundamental mystery of chemistry was formerly the atom. The fundamental mystery of physics was the ether. Now the central mystery of chemistry, physics and electricity is the corpuscle. The chemist had dreamed of a single substance from which all the elements are compounded, and named it pantogen. This dream was realized by the discovery of radio-activity, which disclosed the fact that atoms instead of being indivisible are composite bodies made up of particles 1,700 times lighter than the smallest known atom. It requires 95,000 corpuscles in fixed combination to form a single atom of iron.

"When using the spectroscope it makes no difference whether the light under examination is that of a burning gas in the laboratory, or the light of a flaming star billions of miles away; both reveal their elements with equal clearness without regard to their relative distances. The spectroscopist has shown that in the extremely high temperature of stars matter assumes new forms in consequence of the dissociation of the atoms into corpuscles.

"Sir Norman Lockyer has classified the stars in the order of their temperature. Stars of the hottest class called Argonian, from the star γ of the constellation of Argo Navis, which has a temperature estimated at about 55,000 deg. F. The hottest stars of the Argonian type are in the infancy of their development. Here integration begins and increasing complexity of matter follows every stage of stellar development.

"The Argonian stars are composed almost wholly of hydrogen and proto-hydrogen, the latter being an imperfect or dissociated form of the gas. Alnilam, the middle star of the Orion girdle of pearls, is a leading example of stars of the hottest class. It contains but few elements, some of which are in the proto form. Its temperature is about 45,000 deg. F. Following Lockyer's classification and omitting for the purpose of brevity several classes, we come down to those represented by the great Dog Star, Sirius, whose temperature is probably 25,000 deg. F. Here the number of components is greatly increased and metallic elements, in the proto form, begin to appear. In the eighth class of Arcturian stars the temperature descends to about 15,000 deg. F., which matches that of the Sun, both as to heat and elements. Finally, in Antares and stars of its class, the stellar temperature drops to about 9,000 degrees and there is a break in the phenomena in which light gases disappear and carbon predominates, associated with the heavy metallic elements. A marvelous knowledge of the chemical constitution of this class of stars has been attained.

"At a temperature of 4,000 degrees the existence of water is no longer possible, not even in the form of steam. The heat of the Sun's interior is probably sufficient to dissociate nearly all chemical combinations, consequently solar matter is in its atomic or elementary condition. There is perhaps a maximum temperature for matter, where the violence of the motion of clashing atoms causes them to break up into corpuscles. In stars of the highest temperature like ζ Puppis, this critical motion of atoms has probably been reached, and a large part of the matter of such stars is in the corpuscular state. Each corpuscle has the same mass and same electric charge. Corpuscular matter is therefore in a state of perfect homogeneity; hence, we may say that inorganic progress consists in the change from the homogeneous to the heterogeneous and that the law of inorganic progress is the law of all progress.

"When matter is in its hottest state it is at its lowest point in the scale of evolution, and all progress depends on a fall of temperature by radiation. Bickerton's and Chamberlin's theory of the enormous heat generated by stellar impact agrees with the result of Lockyer's spectroscopic study of the temperature of stars. Lockyer's inorganic evolution, jointed to the spiral nebular hypothesis, and this to geological and biological evolution, complete the evolutionary cycle of the Earth to its present stage.

"Organic life is possible only between the freezing and boiling point. Even a temperature of 140 degrees is destructive to the life of everything except the seeds and spores of a few microscopic organisms; hence in a total thermal range of perhaps 60,000 degrees it is only within the one five-hundredth part of this great thermometric scale that life can exist. It is in the same narrow limits of temperature that chemical action has its freest play, wherein there arises the greatest possible complexity of matter. Here the elements are combined in their most heterogeneous forms and matter is at its highest point in the evolutionary scale.

"The end of all terrestrial life will probably come either by the violence of collision or by quiet refrigeration. Should no cataclysm occur, the Sun and planets would finally sink to a temperature of perhaps 300 degrees below zero. How remarkable it is that the delicate conditions for sustaining life should exist on our planet. It is said that a fall of even 14. deg. F. in the Sun's heat would be sufficient to produce a glacial epoch in our latitude, in which every vestige of life would be destroyed by the formation of ice a thousand meters thick."

The Discovery of the New Element Celtium

WE already have noted that Prof. G. Urbain, of the Paris University, succeeded in separating a new element by treatment of gadolinite, and he calls the new body Celtium. According to the account of his researches which he presents to the Académie des Sciences, the greater part of the rare earths which were the object of his work during recent years came from treatment of large quantities of xenotime mineral. In the ytterbium extracted from such earth he found a new element which he called lutecium. However, he was obliged to discontinue these researches owing to lack of material. Since then he operated on gadolinite mineral in order to obtain a greater amount of lutecium. In pursuing this operation he found an oxide earth which is of a pure white color but shows differences from the other earths of the series containing lutecium and analogous elements. Measurement of the coefficient of magnetization of this oxide gives the value 4.1×10^{-6} which is remarkably low. His best oxides of lutecium extracted from xenotime mineral have coefficients three or four times this value. Spectroscope observations on the substance show besides the presence of lutecium and a trace of neo-ytterbium, that of scandium and negligible traces of calcium and magnesium. The scandium is certainly in too small a quantity in this oxide to lessen the magnetic value due to oxide of lutecium, and the lessening of the magnetism must be attributed to another substance. Comparing this spectrum with those of lutecium, xenotime, neo-ytterbium and scandium, there remained many particular lines which were very strong. Such lines could not be accounted for by comparing with the spectra of other elements. The principal lines of the spectrum of the arc comprised between 2,450 and 3,700 are for the strongest lines 2685.2; 2765.8; 3080.7; 3197.9. About 24 lines are measured in all. The chloride of this oxide earth is somewhat more volatile than the chloride of lutecium and less so than chloride of scandium. Its hydroxide is a more feeble base than lutecium oxide and a stronger one than scandium oxides. The *ensemble* of the other characteristic also brings it near lutecium and scandium. Seeing that there is no doubt about the identity of the new oxide and that he obtained it in a good state of concentration, he considers that there is a new element in question and proposes to call it celtium, with the symbol Ct.

Van't Hoff's Researches and Their Influence on Modern Chemistry

IN the death of Prof. van't Hoff, modern chemistry has lost one of its greatest exponents. A new era in chemistry was inaugurated twenty-five years ago by the publication of Jacobus van't Hoff's investigation of the laws of mobile equilibrium and osmotic pressure. In commemoration of this event, Prof. Ernst Cohen, director of the van't Hoff Laboratory of the University of Utrecht, recently delivered a memorial address, which was published in *Die Zeitschrift fuer Elektrochemie*, and from which the following information is gleaned. The fundamental idea of van't Hoff's great work appeared much earlier than 1885. In 1874 van't Hoff himself, while yet a student in Utrecht, published his views regarding the necessity of spatial interpretations of structural formulæ, and two months later the French chemist Le Bel independently published substantially the same idea. van't Hoff subsequently pointed out that Gaudin had attacked the same problem in 1873. But Paterno had arrived, in 1869, at a definite conception of the tetrahedral arrangement of the atomic groups attached to an atom of carbon, and similar ideas had been expressed by Rosenstiehl a little earlier, and by Pasteur in 1861. We have not yet reached the beginning of the chain, for Prof. Cohen finds a similar view expressed in a paper published by Wollaston in 1808, and Swedenborg was occupied with speculations of this nature as early as 1721.

The discovery of the phenomenon known as osmose is commonly attributed to Dutrochet, Fischer, or Perrot, but the phenomenon is mentioned in the Abbé Nollet's textbook of physics, which appeared in 1754, and in a paper which the Abbé published six years earlier.

Passing over the earlier researches in osmose, we come to Traube's discovery of semi-permeable membranes in 1864, and Pfeffer's investigations of osmotic pressure in 1877.

From 1878 to 1891 Jacobus van't Hoff was working at the problem in Amsterdam. The result of his labors was first given to the world in two essays: "Studies in chemical dynamics," and "Laws of chemical equilibrium in gases and dilute solutions," published in 1884 and 1885, which are to be regarded as parts of an organic whole. In honor of these researches the Nobel prize was awarded to van't Hoff in 1901.

The "Studies of chemical dynamics" contained the first expression of the principle of mobile equilibrium, which asserts that the condition of equilibrium which exists between any two chemical systems at constant temperature is displaced, by elevation of temperature, in the direction of the system which absorbs heat in its formation. This principle has superseded those enunciated by Julius Thomsen in 1853 and by Berthelot in 1867. According to Thomsen's principle every purely chemical reaction is accompanied by evolution of heat. Berthelot's principle asserts that every chemical change, accomplished without the intervention of external energy, tends to produce those substances which evolve the greatest quantity of heat in their formation. Both Thomsen and Berthelot ultimately abandoned these principles, which had guided their labors for many years.

In these two essays of van't Hoff it was shown, furthermore, that the electromotive force of a reversible galvanic cell is a measure of the chemical forces involved in the reactions which take place during the flow of the current. A method of measuring chemical affinity accurately in electrical and mechanical units was thus indicated.

Pfeffer's osmotic researches had interested only students of vegetable physiology, as they had not furnished any simple relation connecting the osmotic pressure, concentration and temperature of a solution. This want was supplied by van't Hoff's "Laws of chemical equilibrium," in which the laws of rarefied gases, which have immortalized the names of Boyle, Gay-Lussac, and Avogadro, were shown to apply also to dilute solutions. This conclusion has been confirmed by the osmotic measurements of Hugo de Vries.

A vast field of research was thus opened, and Raoult's empirical laws of solutions were connected and explained. Considerable deviations from van't Hoff's simple laws were soon discovered, but they were explained by the theory of electrolytic dissociation of Svante Arrhenius. Soon afterward, the seat of the electromotive force of the galvanic cell, which had eluded search during a century, was found by Nernst, with the aid of the new theories, which have since exercised a profound influence on chemical research. The criticisms which have been directed against these theories have been occasioned largely by overlooking the fact that they apply only to dilute solutions.

The Queer Things that Men Eat

THE primitive races of mankind eat many things that seem strange and repulsive to us, though not more so than some of our favorite dainties appears to them. The diet of these children of nature will be well illustrated at the Dresden Hygiene Exhibition, the circular of which, *Hygieia*, gives the following interesting details:

At the end of the rainy season the Bushmen of South Africa go foraging, taking with them their wives and children and most of their earthly possessions. The men hunt, using arrows tipped with a poison which appears to be harmless when taken into the stomach. (The South American Indians claim that the curare which they use for this purpose makes the flesh of the game more digestible.) While the men hunt, the women dig edible roots with sharpened sticks. The favorite root or tuber, called lensho, is as big as a cocoanut, like which it is filled with a milky juice, so that it appeases both hunger and thirst. Caterpillars are collected, killed by crushing their heads and carefully packed in grass for future use. Good water is often a highly prized luxury, and is bottled in antelope skins for transportation.

The natives of Australia live very largely upon the seeds of many species of grasses, for each of which they have a distinctive name. They also eat the seeds of various palms, many roots and bulbs and the gum exuded by trees. A sort of bread is made of the inkua root, and a gruel of karanga seeds. The animal food of the Australians includes ants, caterpillars, cicadas and many other insects. A favorite dish, called tuinamba, is composed of pupa cases. The tent-like coverings which the psylla larvæ infesting the eucalyptus make for themselves out of the sweet and glutinous exudations of the leaves, and their own secretions, are diligently collected and form a dainty which resembles manna and is called paralja. Another delicacy is the flesh of snakes which, with the exception of the liver, is too dry and tasteless to appeal to civilized palates. Meat is usually baked in a primitive oven, made by digging a hole about a foot deep in the ground. In the hole is built a fire which is covered with stones. When the stones have become very hot, the fire is extinguished and the stones are covered with green leaves, on which the meat is placed. The hole is then filled with earth and is not reopened until the time determined for the cooking of the meat has elapsed.

A New Kind of Ice Cream

THE Iowa Experiment Station has issued a bulletin which ought to be joyful reading. Small boys and people of poor digestion, if the bulletin is to be believed, need no longer curb their appetite for ice cream, for the more lacto they eat the healthier they will become. Lacto is a new frozen dairy product invented by the Iowa Experiment Station. It is made of loppered whole or skim milk, with the addition of eggs, sugar, lemons, and flavoring material. It has a very pleasant flavor, and it supplies the body with lactic acid bacteria, which eminent scientists say is a means of improving health and prolonging life.

[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Some Optical Experiments With Liquids

By Prof. Gustave Michaud, Costa Rica State College

AMONG the few liquids which we commonly see or even among the numerous liquids which are commonly used by the chemist there is none which has so high a refractive and dispersive index as carbon disulphide. This fact may be used in the class room or in the home laboratory for the production of some pretty optical effects, the only needed apparatus being a small spherical glass flask and a larger vessel, square-shaped with parallel, plane sides, as shown on the accompanying figure. A preserve jar, of such shape, selected among those which have the planer and most transparent sides, will do. Half of it is filled with carbon disulphide (carbon disulphide is very combustible and its vapor, when mixed with air, is explosive; it is a dangerous substance which should be handled with the utmost care), and the production of rainbows, which testify to the high dispersive power of the liquid, is immediately noticed. The little round flask is then entirely filled with water, its exterior surface is wiped dry, and it is submerged in the carbon disulphide. Its appearance has now completely changed. In the air it was a globe made of thin glass and filled with water. In carbon disulphide it is a submerged globe made of thick glass and entirely empty. The cause of the illusion is obvious. So far as the path of light is concerned, a globe filled with water and submerged in carbon disulphide is comparable to a globe filled with air and submerged in water. In both cases the spherical, less refringent medium occupies the center of the large, parallelopipedic vessel and is surrounded by the more refringent medium. The rays are in both cases refracted in similar directions and give similar impressions.

The carbon disulphide is now poured out of the jar and common kerosene is poured in instead. A solid piece of clean, white, polished glass is submerged in it and the vessel is placed between the eye and a vertical sheet of white paper. Carbon disulphide is now added little by little to the kerosene, and after every such addition the liquids are thoroughly mixed and the glass is examined. It seems to fade away gradually until comes a moment in which it is hard to perceive it. The next addition of carbon disulphide will then bring it back to sight, but this time with a changed, hollow appearance.

Kerosene has a smaller refractive index than that of crown glass, while that of carbon disulphide is much higher. The moment in which the glass is the least perceptible coincides with a refractive index of the mixture which closely approximates that of glass. Light passes

Silver ball appearance of empty flask in carbon disulphide.

then from the liquid to the glass about as if the latter were not there.

For the prettiest optical experiment which can be made with carbon disulphide the empty and dry spherical flask is simply submerged again into carbon disulphide contained in the jar. At first sight the appearance of the little sphere is such as to lead every one to believe that it is but one of the silvered globes that are hung on Christmas trees. The fact is that the greater part of the spherical surface actually reflects light even better than silver does. Only such rays as make a small angle with the perperdicular to the surface of the globe are allowed to pass; the others are incident at an angle greater than the critical angle and undergo total reflection. In the center of the broad silver ring a small but deep hole seems to have been carved, and deep into this hole a small miniature reproduction of outside objects showing a strong stereoscopic relief is perceived, just as appears on a photographic finder when this is a concave lens. This effect is actually produced by the combined action of the two plano concave highly refringent carbon disulphide lenses.

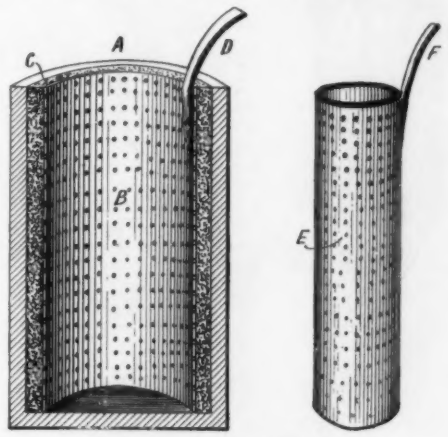
Methyl iodide has a higher refractive index (1.74) than carbon disulphide (1.64) but its price (89 cents an ounce) is almost prohibitive. Carbon disulphide costs but 20 cents a pound.

Warning: Never allow any fire nor any heated object to be brought in the vicinity of a vessel containing carbon disulphide.

A Home-made Storage Battery

By A. J. Jarman

THE construction of storage batteries cannot, as a rule, be undertaken by the amateur and many others, because of the costly plant for making up the cells, such as a powerful shunt dynamo, specially made iron molds for casting the grids, and a complete lead-burning apparatus, considerable skill being required in making a good lead burnt joint, because ordinary solder as used by plumbers and tin men cannot be used for storage battery making. The sulphuric acid solution which is used for the electrolyte would destroy all such joints rapidly.



A home-made storage battery.

The following description will enable any one to make a thoroughly practical storage battery without a lead burnt joint, which can be charged by a current either heavy or light without injury to the positive or negative elements, there being no plates to buckle or grids to break:

Procure as many stoneware jars as required for the number of cells to be made. Obtain some sheet lead four pounds to the square foot, cut this into pieces so as to form a cylinder, allowing about three-eighths of an inch clear space between the inside of the jar and the outside of the cylinder, and punch the lead full of holes about one-eighth of an inch diameter, using twenty-five holes to the square inch. If the lead can be purchased already perforated, so much the better. Bend the lead into a cylinder and rivet a strip of lead cut from the same metal (only not perforated) over the joint where the ends abut. Make this strip three inches longer than the cylinder is high, using leaden rivets made from a narrow strip cut from the same sheet. The strip that is riveted may be one inch wide, and by covering the joint will make a good connection. Make up another cylinder of perforated lead to stand in the middle and rivet the conducting strip upon the *inside* of the cylinder. Allow a space of three-eighths of an inch between this cylinder and the first one, fit into the bottom a piece of plain sheet lead, and turn the lower part of the cylinder over to retain the bottom in place. Now melt some scrap lead in a ladle, get it red hot, and pour it from a height of about five or six feet into a pail of cold water. This will completely granulate the lead. Make up enough to meet the requirements, then pack this granulated lead fairly tight in the space between the perforated cylinder and the jar.

Also pack the inner cylinder full, place on the top a piece of perforated lead, and turn the top edge over to hold it firmly and retain the granulated lead in place. Now cut some strips of wood the length of the space between the inner and outside cylinders, which should be three-eighths of an inch square, soak them in hot paraffine, place these strips so as to effectually separate the inner and outer cylinders.

If only say two cells have been made up, charge them with a mixture of sulphuric acid, one part, and water, ten parts, and couple the strip of the inner cylinder of one cell to the outer connection of the other. Scrape the lead strip clean where contact is made, binding this connection with a brass battery clamp. Now pass a current through the cells by connecting the terminals to direct current lamp circuit, or preferably from a circuit that would be used for vacuum cleaner, or from a good constant primary battery. Allow the current to flow for an hour or two, then disconnect the charging wires, and test the cells for stored energy with an electro-magnet or small motor, or the heating of a piece of fine iron wire. The effect will be astonishing. The voltage will be from 2 to 2.2 volts per cell, and the current may range from one to ten amperes or more, according to the charge. It does not matter how the cells are coupled in the first place for a charging. The inner element made be made the positive, or the reverse. It will not matter in the least, there being no buckling of plates to study, and there may be a heavy rate of charge or discharge, and the cells can be made of any size. For a number of years the writer used a set of thirty-six cells made as described for workshop lighting. Sometimes an arc lamp was used, but generally sixteen candle-power incandescent lamps were employed. The stoneware jars in this case were fitted into square boxes filled in with coal tar pitch. For testing purposes a current as high as 200 amperes was taken from these cells at 90 volts. In fact, as a rough and ready storage cell, simple in construction and high in efficiency, it probably has no equal. The illustration herewith will clearly explain the construction, and any one wishing to make a simple storage battery of any size can do so with a successful result.

The capacity for the storage of energy can be increased considerably by reversing the charging several times after exhausting the cells previous to recharging. The finishing charge should leave the elements as to positive and negative the same as when first prepared. It will be seen that there are neither soldered nor burned lead joints in this cell, all connections being made by lead riveting.

In the accompanying drawing *A* is the containing jar, *B* perforated lead cylinder, *C* spongy or granulated lead, *D* lead strip and connector, *E* central perforated lead cylinder packed with granulated lead, *F* lead strip connector. The steel punch best suited for the perforating is a hollow one costing about twenty-five cents.

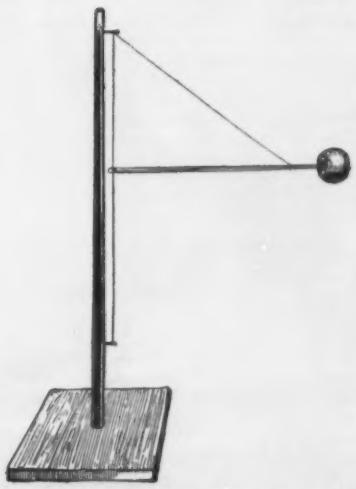
The burrs that leave the punch can be melted and made into spongy or granulated lead, thus aiding in filling the elements of the cells. By placing the sheet lead upon the end grain of a hard wood block the punching can be accomplished readily.

An Electroscope Made of a Board and an Old Walking Stick

A SENSITIVE electroscope, with which the elementary laws of electrical attraction and repulsion can be satisfactorily demonstrated, may be made very easily of the commonest materials, with practically no expense. The materials and the mode of construction may be varied indefinitely. The following simple and interesting method is suggested by a writer in *Die Gartenlaube:*

The stand of the electroscope is constructed by driving the end of an old walking stick tightly into a hole bored for the purpose in the center of a square piece of board, to the under surface of which three small blocks of wood have been glued or tacked to serve as feet, so that the combined board and cane will stand firmly on the table, with the cane vertical. Most articles of furniture have four feet, and this is the reason why they do not stand firmly. Scientific instruments are always mounted on three feet. A fiber of unspun silk is tied at its middle about one end of a light wooden rod, say twelve inches long. The silk fiber is then stretched tightly between the nails driven into the cane and its ends are tied to the nails. The upper nail is connected with the free end of the rod by a second fiber of such length that the rod is supported in a horizontal position.

The free end of the rod must now be furnished with a very light ball or knob. Two natural vegetable products are singularly well adapted for this purpose. One is the oak-gall, the other the fungus called the puff ball, which abounds in the woods in many districts. The puff ball is filled with a fine yellow powder which is scattered



An electroscope made of a board and an old walking stick.

by the slightest pressure. This powder must not be allowed to enter the eyes, for it may cause severe inflammation. A puff ball of the size of a small apple is impaled on the end of the wooden rod and is painted with gold bronze, not for ornament, but to give the ball a surface that will conduct electricity. The cost of the gold bronze (a few cents) is the only expense which has been incurred in constructing the electroscope, which is now complete. We will begin our experiments by rubbing a glass tube or bottle vigorously on the coat sleeve or with a woolen cloth and thus electrifying it, and holding it near the gilded puff ball. The ball immediately moves toward the glass by swinging the horizontal arm round its axis, the vertical silk fiber. This experiment shows that glass, electrified by rubbing with a woolen cloth, attracts an unelectrified body, the gilt ball. If a hard rubber penholder is rubbed in the same way and brought near the ball, precisely the same result will follow. But the following experiments show that the electric charge of the glass is different from that of the rubber. Rub the

glass as before and bring various parts of it into actual contact with the ball, holding the ball steady by grasping the diagonal silk fiber and not letting the hand touch the ball or the horizontal rod. By this operation part of the electric charge of the glass is transferred to the ball. We next electrify the glass tube and the hard rubber again by rubbing them, and present each in turn to the electrified ball, without allowing either of them to touch the ball. We find that the ball is still attracted by the hard rubber but is repelled, or driven away by the glass. If the ball is now touched with the hand, the electric charge which it has received from the glass will flow away to the ground, leaving the ball in its original unelectrified condition. We next give the ball another electric charge by bringing it into thorough contact with the hard rubber penholder, which has been rubbed again, and present to it in succession the glass and the hard rubber penholder, after each has been rubbed once more. We now find that the electrified ball is attracted by the glass, and repelled by the hard rubber penholder.

These results indicate a difference in kind between the "vitreous" or positive electric charge acquired by glass when rubbed with a woolen cloth and the "resinous" or negative charge which India rubber and similar substances acquire under the same conditions. The experiments prove that two positive charges, or two negative charges, repel each other, while a positive and a negative charge attract each other.

Improvised Disk Talking Machine

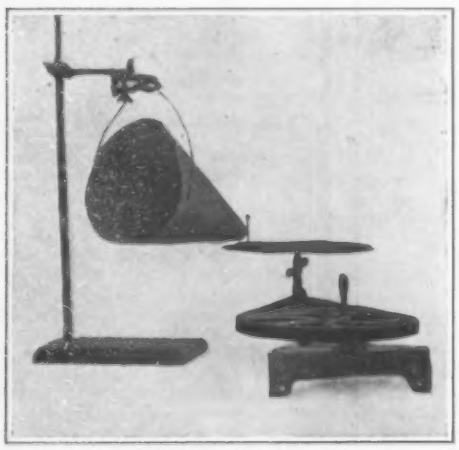
By C. C. Kiplinger, Instructor of Science, Lincoln, Ill., High School

RECENTLY, while studying sound, occasion was had for the use of a gramophone. A very satisfactory substitute was hastily constructed as follows: A whirling machine with siren attachment furnished the rotating table on which the disk record rested, the latter having been made concentric with the siren plate.

This plate turns on a pin, to which, ordinarily, it is tightly clamped by a thumb screw. However, this was left loose, the plate being turned by the friction of the pin in its bearing. This adjustment gave the table a certain freedom of motion and, owing to its inertia, or fly-wheel action, the rotation was rendered very uniform.

The reproducer was unique for its simplicity and surprising efficiency. It consisted of a thin cardboard, or Bristol board, cone about eighteen inches long, a foot in diameter at the larger end, and two inches at the smaller one. An inch and a half from the latter an ordinary carpet or small thumb tack was pressed through the cardboard, from the inside, into a small cork on the outside. A rather thick steel pin or darning needle, about three inches long, was forced through the cork. The reproducer was supported by a piece of wire and a stand, as illustrated. A piece of thin paper was pasted over the opening at the small end of the cone, so as to reflect the sound waves.

The pin must be sharp and should stand at the least angle from the vertical, which insures a clear tone, free from scratching. The quality of enunciation will depend greatly upon the speed at which the siren plate is turned. By varying the speed, amusing results are obtained, and the relation between pitch and rapidity of vibration is demonstrated nicely. A home-made whirling machine



Improvised disk talking machine.

may be used, geared about four to one. The turning table should be rather heavy, and rotate loosely about a shaft, as described above. This reproducer, if properly adjusted, will give results equal to many of the higher priced machines on the market.

A Good and Inexpensive Method of Labeling Bottles Intended for Corrosive Liquids

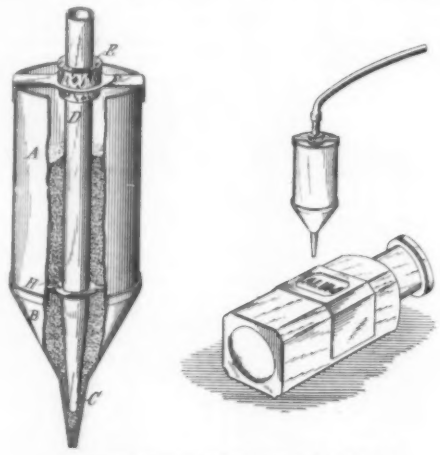
By H. H. F. Clarke

CHEMISTS and others who are engaged in laboratories, chemist shops, etc., often require a label which will not wear off and is not attacked by corrosive liquids.

The ordinary method of covering printed paper labels with paraffin wax or varnish is worthless when dealing with liquids such as sulphuric acid (oil of vitriol). Also bottles on which the labels are sandblasted are so expensive (50 to 75 cents for quite small ones) as to be beyond the pocket of many. In the following way, however, with a small amount of trouble and hardly any cost, bottles may have indestructible labels sandblasted on them. These labels, if done with care, will be found to be equal in durability and appearance to the most expensive bought ones.

A small tinned iron funnel of 1-16 inch diameter at small end is taken and fitted with a barrel instead of the usual collar.

Before this barrel is fitted, a cross piece of tin, *H*, is soldered on one of the ends. This serves to keep the glass tube in place. On the other end of the barrel another strap, *F*, is soldered. In this one the hole must



Inexpensive method of labeling bottles.

be larger than the first case to allow the cork *E* to pass through. The object of the cork is to prevent the glass tube *D* from slipping down and so blocking up the orifice of the funnel.

Now take a piece of ordinary glass tubing (¼-inch diameter) and draw out one end. Then cut the reduced portion with a file so that the orifice will be about 1-16-inch diameter. When this is done the piece of tubing, *D*, should be of such a length that when the constricted end comes to within ¼ inch of the funnel's outlet the other end should project about 1½ inch beyond the other end of the apparatus. Bore a hole in a cork (½ inch diameter at smaller end), *E*, of such a size that it holds the tube tightly. Pass the glass tube through the hole in the cork and then put them both through the hole in the first strap. Push the cork in firmly and then press the tube carefully until it passes through the other strap, which keeps it in place, and comes to within about ¼ inch of the outlet of the funnel.

Then holding the whole apparatus vertical fill the funnel about three-quarters full of fine, sharp sand. It is better if the sand is sifted through a piece of iron gauze, about 25 or 30 mesh, before using. This removes all the lumps, etc., which would, perhaps, block up the orifice. Connect the wide end of the glass tube to an ordinary foot bellows, giving a pound or two pressure per square inch, with a piece of rubber tubing.

Now take the bottle to be labeled and paste or gum a couple of thicknesses of brown paper at least half way around it. It is necessary to be very careful and see that no bubbles of air are caught under the paper where the label is to be. Cut an oblong out of the paper the size of the required label. The cut edges must fit closely to the bottle. Now set it aside to dry. When dry, with a fine brush and a paint made by thinning white lead with boiled linseed oil until it is of the consistency of cream, print the required name as carefully as possible on the bare glass within the rectangle. Boiled linseed oil must be used, unboiled will not do. Care must be taken to arrange the name neatly. Again set it aside to dry.

When dry put the bottle, label uppermost, on a large sheet of paper, the edges of which are turned up to prevent the sand blowing about. Now hold or clamp the funnel vertically over the label and pass a stream of air with the foot bellows through the apparatus. A fine jet of sand will be projected against the bare glass. If too much sand comes through press the glass tube until the drawn out end comes closer to the outlet of the funnel and *vice versa*.

Stop the operation from time to time and look at the label. The depth of the impression depends on the force of the stream of sand and the length of time it plays.

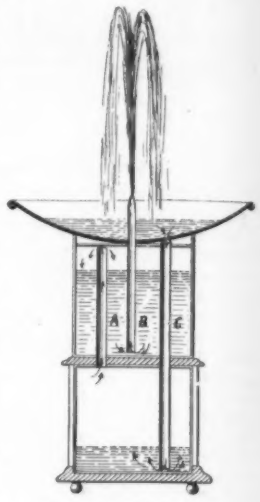
When in the opinion of the operator the label is clear enough, that is when the background has been eaten away to the right depth, take the funnel away and soak off the paper wrapping. The paint may now be removed with oil of turpentine and the result will be a neat, legible and indestructible label.

In very dry weather the sand is apt to fly about. This may be remedied by covering the paper on which the bottle rests with a thin layer of moist sand. The disadvantage of this method is that the sand when once used must be thoroughly dried before it can be used again.

This method may be employed in roughening blank labels on beakers, flasks, crystallizing dishes, etc. Only in this case it is much easier, the troublesome printing not having to be done. The advantage of these blank labels is that the name of the contents can be written on these roughened spaces with an ordinary lead pencil. When this substance is replaced by another the first writing can be easily removed with a wet rag and the new name put in its place.

Table Fountain

THE accompanying design of a small self-acting fountain may interest some of the readers of the Home Laboratory Department. The basin is made of copper or zinc, 15 inches in diameter and 4 inches deep, with a ½-inch hole in the center for the jet pipe, and a ¾-inch hole slightly to one side for the overflow pipe. Underneath the basin are the two tanks made of zinc, both resting on wooden shelves, the two shelves being framed together with wooden corners.



Hero's fountain as an ornament.

The pipe *A* is soldered at the lower end to the tank. The jet *B* is fitted into the basin of the fountain with a flanged joint, and is kept slightly clear of the tank at the bottom. The pipe *C* is soldered into the top tank and basin. This pipe is then carried down through the two tanks to within ¼ inch of the bottom.

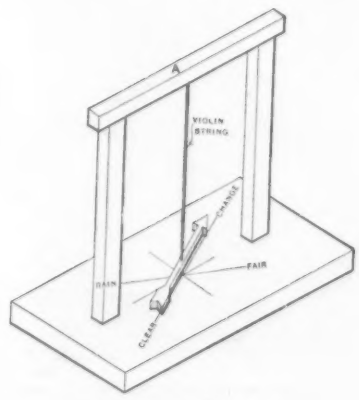
The fountain having been fitted together, we will now consider the action of starting the fountain. Water should be poured into the basin and will run down the pipe *C* until the lower tank is filled. The entire fountain then must be turned upside down, when the water will pass by the pipe *A* into the upper tank, which, being of equal capacity, will be filled when the other is empty.

Now set the fountain again in its original position, when the basin will gradually fill with water, which will rush down the pipe *C*, thereby compressing the air in the lower tank, and forcing the air into the upper tank through the pipe *A*. The compressed air acting on the water in the upper tank will cause the water to be forced up the pipe *B*, which will fall back into the basin and so keep up the pressure until the water in the top tank has been forced through the jet. The upper tank may be refilled by reversing the fountain.

A Simple Hygrometer

WE often hear of goose bones, rheumatism, and old wounds being used by their owners as barometers, and if reports are true, they never fail to predict accurately; but as the last two at least are apt to register other things than changes in the weather, the Handy Man who wants a home-made barometer would do well to leave them alone. As a matter of fact, it is the moisture in the atmosphere rather than the atmospheric pressure that is indicated by such means.

A satisfactory hygrometer can be made at small cost and in a short time in the following way: From a cross piece suspend a pointer weighing about two ounces by



A simple hygrometer.

a violin string four or five inches long. Set it in a place where the outside air can reach it, and the pointer will swing from side to side as the weather changes. After several days' observation a scale can be marked on the base.

This is the simplest form in which it can be made. It can be worked up in more elaborate designs, a familiar example of which are the little German weather houses which are to be seen in the store windows.

Liquefaction of Nitric Oxide

A LETTER from Prof. Graham, which we published in our issue of February 25th, has brought to us a response from Mr. R. H. Bowen, in which he explains that the title he gave to the article which he contributed to our issue of January 21st was an error. This title should have read "The Liquefaction of Nitrogen Peroxide." Mr. Bowen assures us that he has actually performed the experiment with successful results.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The Inventor and the Patent Office

THE fundamental principles upon which the commercial supremacy of this nation is based are three things which are mentioned in the Constitution of the United States; first, the granting of free speech; second, the offer of remuneration for the use of the products of the brain by providing a limited period during which a man shall enjoy the fruits of his efforts; and third, the protection of personal property by the provision that no person shall be deprived of his property without due process of law.

The Constitutional provision mentioned as second is as follows: "The Congress shall have power . . . to promote the progress of Science and Useful Arts by securing for limited Times to Authors and Inventors, the exclusive Right to their respective Writings and Discoveries."

Upon this foundation stands the United States Patent Office, established for the purpose of carrying out the intentions of the framers of the Constitution and developed far beyond their fondest dreams, by American ingenuity and perseverance.

But how shall the inventor avail himself of this privilege, this right that was born with the Nation and which has been handed down to him as a heritage to encourage his talents and develop his ideas? The entire process by which every citizen of the United States may profit by his country's laws as far as they apply to the protection of his inventions, should be an open book to him. It is worth while, then, to give a brief glimpse of how a patent is procured, from the time that the inventor has perfected his conception, to the time he is handed United States Letters Patent, giving him seventeen years of uninterrupted control over that which he has evolved.

Let us suppose that our familiar friend "John Smith" has invented a bottle stopper or seal. It is simple and can be inexpensively made, and is therefore apt to be acceptable to dealers in bottled materials which must be kept from contact with the air.

"Smith" has worked long and hard over his device, and he sees in its consummation a future of ease and comfort for himself and his family. These are not vain hopes nor idle visions, because he knows that people who invent new and useful things make money.

The first thing the inventor thinks of, however, is that he must have his invention protected so that he alone may enjoy the fruits of its success. Not that he is of an unduly suspicious nature, but the American inventor combines with his genius, a goodly portion of that desirable characteristic—common sense.

To whom shall he first turn? To a manufacturer of bottles? Not yet, for he does not know what manufacturer of bottles he can trust with his great discovery. To a whisky or a patent medicine concern? Again the answer is in the negative. Such firms frequently make their own bottles and it is difficult to tell which one is willing to give the inventor a fair chance.

Two other courses are open to "Smith." Either he can apply directly to the Patent Office, or he can put his case in the hands of a patent attorney. From the Patent Office he will obtain two blank forms—one a petition, the other an oath. The Patent Office has several hundred requests every day of this kind, and while it has a very large force of clerks to answer such inquiries, it is very plain that no special attention can be paid to "John Smith." A clerk will send him the Rules of Practice, and he is then expected to prepare his specification, his petition, and his oath, and send them, with the first government fee of $15, to the office. He is also given directions as to how to prepare his drawings, although the Drafting Division of the Patent Office will prepare these for a fee amounting to just enough to cover the expense.

Right here it may be stated that while it is not one of the requirements of law that an inventor shall employ a patent attorney, the Patent Office would very much prefer that he should. It is greatly to his interest that he should do so, for the reason that the scope of a patent is determined by the formal claims with which the patent closes. These claims are technically phrased statements of what the inventor believes to be his invention and are expressed with sufficient breadth not only to describe the particular device illustrated in the inventor's drawing, but are broad enough to cover other devices, which, though dissimilar in form, may be capable of performing the same function. A layman would undoubtedly prepare the claims like the famous "renter's lease" and thus restrict the scope of his patent, leaving opportunities for others to manufacture almost the same device, without actually infringing his patent.

"John Smith," we will suppose, adopts the remaining and wiser course. He engages an attorney, and this attorney will make the "preliminary search." The records of previous inventions in the art of bottle-stoppers are carefully scanned to see whether "John Smith's" idea has been already patented. The value of this search is at once apparent, for if the attorney finds that the idea is not new, he so informs his client, who is thus spared the expense of prosecuting his claims through the Patent Office.

Mr. Edward B. Moore, Commissioner of Patents.

In the large Search Room of the Patent Office, patent attorneys and their assistants sit and delve through the records. It is a busy scene at every hour of the day, and it is a sight that furnishes reflection as to the high hopes that are here encouraged or dashed down, and one which inspires an admiration for the perfect system that makes it possible for the inventions under any given subject to be assembled in one spot to serve as a guide for those who seek to improve upon the methods and the devices of those who have trod the paths of invention before them.

The search completed, the attorney finds that nobody has invented a non-refillable bottle like his client's. He then writes to "Smith" and tells him so. "Smith" now authorizes his attorney to prepare the specifications and drawings and these are forwarded to the Patent Office along with the petition and the oath, and the preliminary fee. These constitute a formal "Application for Patent." The wheels have begun to revolve and the machinery which is to transform "Smith's" germ of an idea into a piece of marketable property, is already at work.

The Application Division of the Patent Office first receives these papers. It is here that they are duly entered in books and given the serial number that every application must bear. In the books of the Application Division are records of patents reaching back beyond the memory of the present generation of clerks, far into the past which covers that vast field of inventive achievement, which forms such a proud page of American history. It means something to "Smith" to have his name enrolled in these books. He has taken his place, as it were, a volunteer in the ranks of the great army of American inventors. Who knows but that he may not come out a full general, a leader—a success?

From the Application Division, the fee having been properly receipted for by the financial clerk, and the money deposited in the United States Treasury, the papers now go to the examining division. There are forty-three such divisions in the Patent Office, representing the various classes of inventions, and each is in charge of a principal examiner, who has a corps of skilled assistant examiners.

In the case of "Smith" the application is sent to the division where all kinds of bottles and jars are examined. The examiner reads the case carefully in order to familiarize himself with the invention disclosed.

The drawings are compared with the specifications with painstaking care, and the examiner makes an examination of the class to which the device belongs, an examination similar to that originally made in the Search Room by the applicant's attorney. In the examiner's case the search includes not only the classified American patents, but also the patents granted by a majority of the foreign nations, especially Great Britain, France, Germany, Switzerland, etc., and the publications in the Scientific Library. When the assistant examiner has reached a conclusion, his work is reviewed by the principal examiner, and the applicant is notified, through his attorney, of the result of the consideration given the case.

Supposing that the bottle stopper is found patentable, the examiner now passes the case to issue, and it is ready for the Issue and Gazette Division, whence, as soon as the final fee of $20 is paid, the specification is sent to the Government Printing Office, to be returned shortly printed in such form as to be ready to combine with the reproductions of the drawings, already prepared by the photolithographer, enclosed in a cover in book form, with the ornamental frontispiece, the seal of the Patent Office attached, all ready for the Commissioner's signature. A brief description of the patent is prepared for the Official Gazette, the weekly report of patents granted.

Once a week the granted patents are sent to the Commissioner's private office in a large basket, where he approves and signs each one. In his absence this work may be done by the Acting Commissioner.

When this completed patent is handed to "John Smith," he possesses for a period of seventeen years, a piece of marketable property, whose value may be such as to earn for him large sums of money, particularly if it is an article which fills a public need.

The foregoing description of the way an application for a patent goes through the Patent Office is, of course, based on the supposition that there are no obstacles in its way. If, for instance, the examiner should find certain prior patents, which, in his opinion, anticipate "Smith's" bottle-stopper, he enters into correspondence with the attorney, and it then becomes the business of the attorney to adjust the claims to distinguish novelty over prior patents. These objections are usually readily overcome, but in some cases adjustment is impossible and the application is finally rejected.

Sometimes the examiner's objections are treated facetiously by the attorney. One case is recalled in which the examiner objected to a claim as being too indefinite. He promptly replied and requested that the examiner indicate just how indefinite a claim might be. But it does not pay to be facetious in a matter which is of so much real importance as a patent application.

The correspondence of the Patent Office, like that of any large business house, includes many letters and inquiries of the "freak" variety. Members of Congress are besought by their constituents to do all sorts of impossible things. "Please go to the Patent Office and get me a patent," writes one constituent, a dweller on the edge of civilization. He thinks the Congressman can wait until the patent is made out and handed to him, and drop it in the mail box on the spot. The matter of searches, specifications, fees, amendments, etc., disturb him not at all. And the class of inventors of this kind is by no means small. It seems to be a peculiarity of genius to know nothing at all of formal procedure.

The inability of the inventor properly to describe his device, or adequately to picture it, causes his attorney much embarrassment, and involves a correspondence of large dimensions.

Cases which have been finally rejected may be appealed, first to the Examiners-in-Chief, who must review the findings of the primary examiner, and hand down a written decision. The Board of Examiners-in-Chief is composed of three men thoroughly versed in legal and technical procedure of the office. If the applicant and his attorney are dissatisfied with the findings of the Board, there exists the right of further appeal to the Commissioner in person, or either of the assistant commissioners, who, sitting as court, makes the final decision so far as the Patent Office is concerned. From this decision, appeal may be taken to the United States Court of Appeals of the District of Columbia. Of course, only a very small percentage of rejected applications runs the limit of appeals, but where the invention involved is of signal importance, much time and money is expended in thus acquiring the right to a patent.

In the event of two or more persons claiming the same device, it is very necessary for undivided ownership to be legally established, and accordingly an interference is declared.

An interference is a proceeding in the nature of a suit to determine which of two or more parties claiming the same invention is the first inventor. The interference is declared by the primary examiner and the parties are called on to file statements setting forth in detail the different steps followed by them in conceiving and completing the invention. It sometimes happens that one inventor does not claim to have first conceived the invention until after the other had filed his application for a patent. In such case judgment will be awarded on the record to the party first filing the application, unless the other party should show some cause why the judgment should not be so rendered. In doing this motions may be made before the Examiner of Interference to dissolve the interference on various grounds, some of which are that the interference was improperly declared, and that the invention is not patentable to either or both of the parties. This leads to a test between the parties and sometimes in a series of interferences, involving the same application, the applicant will first assert strongly the patentability of the invention when he has prevailed on the record—that is, when he has been the winner of the interference—and in the second case, where judgment on the record is threatened against him, he may wish to show that the invention is not patentable. Thus the applicant is in the position, which Shakespeare describes in "As You Like It," when he makes Jacques say: "One man in his life plays many parts."

When the interference is finally proceeded with, the parties are put to the

proofs and take their testimony. Sometimes before doing this they realize their positions and adjust the matters between them. One case is recalled where a prominent captain of industry in a western State made an important invention along the line of his business. An associate made an invention at about the same time, and the two assigned an interest in their respective in-

C. C. Billings, First Assistant Commissioner of Patents.

ventions to each other, neither knowing what the other had invented, and the applications for patents were duly filed. When the inevitable interference was threatened, the captain of industry said to his associate: "Look here, these are our applications. Let's go to Washington and fix this matter up." They accordingly came all the way to Washington to settle which was the first inventor when their pecuniary interests in the inventions were already preserved.

In taking the testimony for the different parties, some of which is a highly technical matter, required to be in strict accordance with the patent rules, the witnesses are examined and cross-examined, just as in depositions for other suits, and finally, after all testimony has been taken, the cases come on for hearing before the Examiner of Interferences. Prior to this the testimony and the briefs in behalf of the interfering parties must be printed, all of which involves expense and necessitates the assistance of skilled, trained attorneys.

The Examiner of Interference then renders his decision as to the matter of priority, limit of appeal is fixed and appeal may be taken within that time to the Board of Examiners-in-Chief, who, after the case is fully argued, render their decision. Then an appeal may be taken from this tribunal to the Commissioner of Patents in person, and from the Commissioner's decision to the Court of Appeals of the District of Columbia.

Sometimes in the course of an interference, one of the parties will endeavor to change the date of his conception of invention on the record. When this attempt is made after he has had full access to his opponent's dates, the reason for such change must have the support of evidence that is unimpeachable, since the courts have held that amendment upon so important a point should not be allowed unless it is shown that the interests of justice clearly demand it, "for upon the determination of these dates," says the Court of Appeals of the District of Columbia, "it depends, in the majority of cases, which party is entitled to the patent, and a change of memory is comparatively easy when self-interest dictates a different date."

It will be seen, therefore, that the Patent Office and the Courts are fully awake to their responsibilities in protecting the inventors. One feature about the appeal to the Court of Appeals of the District of Columbia is that such court has no power to attach costs against the losing party, so that the entire cost of taking the appeal to the court is on the appealing party.

Of course, it must be remembered that interference proceedings are extraordinary and are not often encountered in applications for patent.

The higher ramifications of the progress of an application through the Patent Office, present many aspects of law and technical procedure, and the practice involved is both interesting and intricate.

A large majority of inventors, however, find that their applications run to a peaceable issue. A few changes may be necessary to secure the coveted claims, but in the hands of capable attorneys, these are easily made. The hand of the Patent Office is ever outstretched in behalf of the inventor, and his interests are carefully conserved. Indeed, the first head of the Patent Office, Dr. William Thornton, held that "the patent law was made solely for the encouragement of authors and inventors, and not to collect a revenue."

The office, though not originally intended as a source of revenue to the Government, has proved to be one of Uncle Sam's few money-making enterprises, and that this has been possible is a high tribute to the perseverance and ingenuity of the American people.

The Hodgkinson Salt Process

IN recent newspaper dispatches it was stated that the United States and Canadian rights in the invention of Mr. James Hodgkinson, of Manchester, England, had been sold for a large sum of money. The invention is revolutionary, and as sometimes occurs, instead of being the result of years of experience and development by a practical man in the business, it is really an inspiration received by Mr. Hodgkinson in a visit to the salt works. He saw at once that the antiquated and expensive method of producing salt could be supplanted by a simple process which would save enormously in fuel, and in the handling of the salt. It is one of the instances where men who have been born to the business keep in the rut or groove before them, and it takes a mind wholly unfamiliar with the art to see the room for improvement.

Mr. Hodgkinson is a man of unusual experience, attainments and ability, and has the inventive faculty highly developed. Prior to his discovery the salt industry was carried out on a large scale near Manchester, but in the crudest possible manner, viz., by pumping the brine into tanks or pans, and providing a furnace for each tank or pan with a big stack or chimney, the water being slowly evaporated and salt crystals precipitated. This was not only slow, but very expensive, and required pretty nearly, if not quite, a ton of coal to produce a ton of salt. Another serious objection to the old method was that the crystals were of irregular size, and hence to get them fine enough for use as table salt, for instance, it was necessary to grind them, which was objectionable for many reasons; first, because the salt, after being ground, contained the dust of grinding, and a second handling of the crystals was, of course, required. Different grades of salt are required, as is well known, the grades varying as to size of crystals, and used for different purposes, according to the special requirements, such as butter salt, fish salt, and the like.

The thoroughly experienced salt men laughed at Mr. Hodgkinson's proposal to revolutionize the art of salt making, and resented the bare suggestion as coming from a rank outsider; but he persisted and proved his contention in a crude way. There was still so much skepticism that he was compelled, at his own expense, to put up a practical operating plant. The result has come up to his greatest expectations, and he has been enabled to do what never has been done before, and in the simplest possible manner, viz., to produce the finest table salt by direct precipitation without re-grinding, and to secure as many other grades of salt as he desires, controlling the grades at will, by precipitating the salt of a uniform size of crystal in various pans, from the finest to the coarsest. Instead of the wasteful method now practised, he utilizes every particle of heat from his furnace, passing the products of combustion from one pan to another, and drawing the spent gases practically cold from the rear of his plant by a fan, requiring no stack or chimney, and discharging a smokeless gas at the rear. The process makes such a saving as to produce from seven to ten tons of salt by the use of a single ton of coal, and without regarding the great economy secured in the fact that the salt, as it comes from his plant, is ready for use without further manipulation.

The writer has not only personal and intimate acquaintance with Mr. Hodgkinson,

Assistant Commissioner of Patents Frederick A. Tennant.

but had the pleasure of a visit with him last year, and visited Northwich, the salt district, and inspected the remarkably complete plant which Mr. Hodgkinson had erected at a very large expense, showing his own faith in his process, and his belief that it would revolutionize the salt industry. His understanding was that while Mr. Hodgkinson erected this at his own cost, it was on a definite agreement with the Salt Union, a concern controlling the salt industry in Great Britain, that they would take the plant up when the process was demonstrated to their satisfaction, and not only pay for the plant, but pay Mr. Hodgkinson a handsome bonus and a royalty per ton of salt produced. The plant was of large proportions and perfect in its workmanship, and justified every claim that Mr. Hodgkinson had made for it.

Chief Clerk William F. Woolard of the United States Patent Office.

Examiner-in-Chief Fairfax Bayard.

Copyright by G. V. Buck.

Examiner-in-Chief Thos. G. Steward.

Examiner-in-Chief Frank C. Skinner.

Brief Notes on Inventions

The Bible as a Patent Reference.—The late George Seely examined the class of electrical distribution and had charge of electrical conduits during the modern development of that art. An applicant, early in the history of the art, presented a conduit of wood coated inside and out with pitch, and it was promptly refused by Mr. Seely on reference to the fourteenth verse of the sixth chapter of Genesis "Make thee an ark of Gopher wood . . . and shalt pitch it within and without with pitch."

Investigating the Match Trust.—Following the recommendations of President Taft, looking to the prohibition of the use of white phosphorus in matches on account of its deleterious effect upon the health of match factory employees, the House of Representatives adopted on February 27th, 1911, a joint resolution having for its object to secure an investigation of the so-called match trust. The investigation is to be conducted by or under the direction of the President, who is authorized to consider those features of the present mode of manufacture which affect the health of the employees, how the dangers to the employees can be minimized by the use of substitutes for white phosphorus, and as to any existing patent protection for such substitutes.

Familiarity Breeds Contempt for Necessary Improvements.—It is not always the one most familiar with a subject who sees a needed improvement. An intelligent traveling man told the writer he spent two hundred nights a year on a sleeper. When I asked him to state me some improvement needed in the traveling lodging house he was actually embarrassed. "Why!" he said, "there seems to me to be nothing needed; everything seems all right." His constant use of the cars had worn callouses at all spots of contact, and he was content. If you patronize the sleeper once or twice a year, notice the first hundred miles of your next trip, and the odds are heavy you will be able to suggest from one to five improvements.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

The weekly *Index of Patents* issued by the *United States Patent Office* will be found in the *Scientific American Supplement*.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COMBINED BELT PIN, GARMENT RETAINER, CORSET PROTECTOR, AND WAIST FORMER.—F. M. KEARNS, Fresno, Cal. The improved device is adapted to retain a lady's waist and skirt in the desired position to produce a short or long-waist effect, and at the same time to hold the belt in place and protect the corset against injury through repeated pinning the garment thereto.

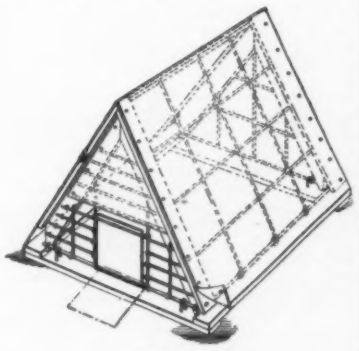
Electrical Devices.

PUSH BUTTON.—C. AUTH, New York, N. Y. The intention here is to so form the terminals that the wire cannot become separated from the terminals during the insertion or replacement of the button within the cavity, and a further object is to provide for the rapid and easy removal of the button proper from the casing, without necessitating the use of special tools.

VARIABLE SELF INDUCTION COIL.—A. C. HOVEY, Pittsburg, Pa. In this case the invention relates to variable self-induction coils, the more particular purpose being to provide a coil which may be so used as to dispense with a rheostat or to avoid the necessity for a choking coil, and in which the voltage may be readily controlled at will.

Of Interest to Farmers.

COOP.—MILTON J. STOKES, Terre Haute, Ill. The coop shown in the engraving is easily kept in a clean and sanitary state. The invention in general consists of an open base, triangular ends and sides; the ends and sides hinged to the base and folding thereon, and the sides adapted to seat on the ends when the latter



CHICKEN COOP.

are turned upright, and form in connection therewith a coop, the sides each having rigid side bars and reticulated covering, fasteners arranged on the side bars of the sides, and a flexible covering for the sides adapted to be detachably applied thereto by the fasteners.

STUMP ERADICATOR.—M. S. PRESLER, Kellogg, Idaho. The invention refers to a stump remover, of a type adapted to form a furnace around the stump and destroy the same by fire. An object is to so construct the device that an opening will be presented to the wind from whatever direction it comes, adjacent the bottom thereof, so as to form an upward draft therein, and at the same time direct the outlet away from the wind, so as to cause a suction through the device.

WING CARRIER.—T. L. CUMMINGS, Spencer, Iowa. The invention provides means for folding carriers to nest upon the structure of the threshing machine to which they are applied; provides for varying their operative positions; provides a driving mechanism for a plurality of carriers operable from a single source; provides removable guide boards for carriers and means connected therewith for lapping a plurality of carriers to constitute a single conveyer, and provides transmission mechanism flexible and universal in form to accommodate variation in angular relation to the carriers.

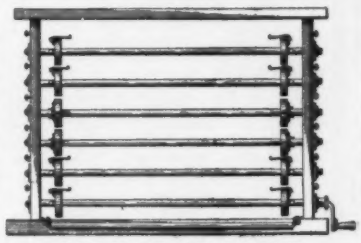
Of General Interest.

DIE MAKER'S SQUARE.—F. J. BADGE, New York, N. Y. In the present patent the invention is an improvement in squares such as are used in determining the clearance on dies, by which is meant the angle of the sides of the die impression, and has in view a square in which the blade can be accurately and readily set at any angle to the stock within certain limits.

DEVICE FOR HOLDING AND DISPLAYING BROOMS.—E. G. DRUDING, Ellsworth, Wis. This device is adapted to retain brooms or similar articles in a readily accessible position when exposed for sale. It is also adapted to hold and display brooms, which may be supported in such a manner that it can be readily rotated to bring successive brooms in closer juxtaposition to a storekeeper or a purchaser.

APPARATUS FOR ENRICHING GAS.—E. A. DIETERLE, Seattle, Wash. The aim of this invention is to provide an efficient apparatus for manufacturing gas of a high grade with a minimum expense and continuously. The casing is filled with brick and may be of any suitable shape, size and material; the last having poor heat conducting qualities, preferably fire clay. An advantage is, that in the actual operation of the apparatus, the chambers are alternately mixing and combustion chambers.

FABRIC HOLDER AND EXHIBITOR.—FRANK A. RAABE, Stanton, Neb. Means provide in the apparatus shown, for eliminating all creases and wrinkles, or, in other words, the fabrics are smoothed preparatory to winding on the exhibiting rollers. Each fabric roller has a groove for use in holding an end



FABRIC HOLDER AND EXHIBITOR.

of the goods or fabric when trying to roll it, the ends of the fabric being inserted in the groove and held therein by friction, so that it is prevented from slipping when the roller is rotated. Each roller has two guides set a distance apart corresponding to the width of goods to be wound, it being assumed that in cases fabrics of different widths may be wound in the same operation. Each guide has a clamp whose action prevents the rolled fabric unwinding accidentally.

SHELF ATTACHMENT FOR TENTS.—W. C. BROWN, U. S. Army, Washington, D. C. The invention is embodied in a useful and inexpensive shelf-like attachment for tents of rectangular plan with a wall, such as wall tents, common tents, and hospital tents used in the U. S. Army, the same serving as a supporter or holder for various articles used by the occupants of the tent. The shelf is foldable with the tent.

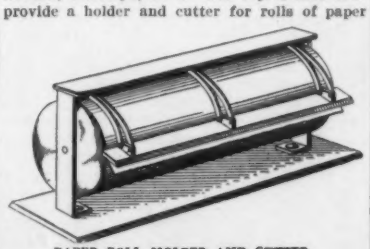
DINNER PAIL.—REV. W. A. EDWARDS, Pine Bluff, Ark. An object here is to provide a device in which there are a number of separate trays for carrying food, with means for ventilating each tray. The trays are readily accessible and means provided for locking them when in position. Carrying means is arranged for liquids in such a manner that the latter cannot be removed until the cover is raised.

FORM FOR THE CONSTRUCTION OF CONCRETE WALKS, FLOORS, CURBS, GUTTERS, AND LIKE STRUCTURES.—M. S. HOTCHKISS, Binghamton, N. Y. The intention in this improvement is to provide a form for concrete structures, and arranged to insure perfect alinement of the sections of the form and stability of the form without requiring stakes or braces, and to permit of conveniently and quickly assembling the form parts into a self-sustaining mold.

GREENHOUSE BENCH.—J. H. PLADECK, New York, N. Y. Among the principal objects which the present invention has in view are: To provide a bench for the earth employed in greenhouses, so arranged and constructed that the same may be dumped with ease and quickly; and to provide an economical, efficient and durable construction for a frame for holding the bench in a raised position.

CALK BEARING OVERSHOE.—G. S. MEYER, Newburgh, N. Y. In carrying out this invention, the calks are secured to a member separate from the overshoe and detachable therefrom, the member being secured in place between the overshoe and the under side of the horseshoe. A perforated plate is also provided secured to one member of the overshoe and adapted to co-operate with a movable tongue connected to the other member, by means of which the members are held in place.

PAPER ROLL HOLDER AND CUTTER.—RAYMOND P. HENDRICKSON, 222 Washington Avenue, Brooklyn, N. Y. The object here is to provide a holder and cutter for rolls of paper



PAPER ROLL HOLDER AND CUTTER.

or the like, by means of which the roll can be rotatably supported, which serves for severing from the roll pieces of different lengths, as they are required, and in which the blade against an edge of which the paper is severed, is movably mounted so that it maintains a constant angle with the horizontal, regardless of the thickness of the roll, whereby it is possible to sever pieces from the roll with equal facility at all times. The device illustrated herewith is for use with rolls of paper or other material which is used in pieces severed from the rolls.

MAGAZINE PLATE HOLDER.—R. GOLDSTEIN, New York, N. Y. The plate holder is arranged to hold a plurality of sensitive plates without danger of the same becoming light struck, and to allow of conveniently transferring a sensitive plate from the holder to the camera. The holder is formed of two sides and an intermediate member, having cut out portions for forming individual chambers for the reception of the sensitive plates.

DERRICK.—G. FRINK, Seattle, Wash. While the derrick may be of the stiff leg type, it may also be of other types, as, for instance, guy derricks. The objects here are to reduce cost, to render the arrangement of the pulleys more compact than heretofore, to enable the boom to be brought in closer to the mast without fouling blocks, and with the same length of boom to secure a higher lift.

HOSE DRIER.—B. M. WILHITE and F. I. LETSON, Gordon, Neb. The drier is preferably in the nature of a vehicle, so that it can be driven to the fire and used immediately after the fire, the drier having an oven, and the air pressure tank arranged within the oven, having a valve-controlled outlet provided with a hose connection, the air pressure tank being supplied by a pump adapted to pump the air supply from the open air, from the oven or from the flue of the heater which heats the oven, thus enabling the temperature of the compressed air to be readily controlled.

Hardware and Tools.

CLASP.—E. S. KELLEY, Kelley's Cove, Nova Scotia, Canada. This invention is an improvement in clasps suitable for clamping articles generally, but especially adaptable as a holder or clasp for a cow's tail, the clasp embodying two approximately U-shaped clamping members of spring wire, with the arms of the members flanged together to permit of the members swinging to and from each other. The members have gripping jaws, each set of which are provided with intermeshing, gripping helices, to engage the article to which the clamp is applied without danger of cutting.

HAMMER.—A. GRANT, Beeville, Texas. Means provide that the hammer head may be secured to the handle in such manner that the head cannot fly off the handle, and this is done by constructing the head with a laterally opening dove-tail or under-cut recess with its smaller end open and leading from the lower side of the head, and forming the handle with a head fitting the recess and secured therein.

HINGE.—O. KATZENBERGER, Chicago, Ill. The hinge is especially an improvement in such as are known as "jamb" hinges, and the inventor has in view a hinge leaf, ordinarily the center or intermediate leaf, which is adapted to be stamped from a one-piece blank of sheet metal or material and provide such reinforcement for the oppositely-arranged knuckles as to make it impossible to break or bend them from the body of the leaf under ordinary strain.

FOLDING CHAIR.—S. G. KRILE, San Francisco, Cal. The purpose here is to provide a form of chair that may be made so that the base and the seat can be separated and compactly folded, and wherein the seat and back stays may be removed and readily replaced, and wherein when the seat and back sections are properly placed upon the base section the chair will be as firm as a one-piece chair.

PIPE WRENCH.—E. ENDERES, Littleport, Iowa. The invention comprises a fixed jaw on the wrench head and a movable jaw coacting therewith and having a shank that is movable transversely in an opening in the head. The shank of the movable jaw has a slide that carries a spring pawl engaging ratchet teeth on the shank for holding the movable jaw in the adjusted position.

Household Utilities.

COMBINED HOLDER AND RECEPTACLE.—AUGUST GRADEL and GEORGE GRADEL, 818 John Street, West Hoboken, N. J. The object of this invention is to provide a combined holder and receptacle, particularly adapted for use on gas stoves, the holder being required to hold the gas hose and the receptacles to conveniently hold matches. For the purpose mentioned use is made, as shown in the en-

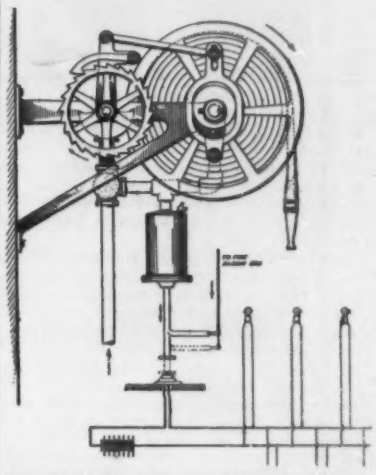
COMBINED HOLDER AND RECEPTACLE FOR GAS STOVES.

graving, of a body provided with a clamp, and receptacles secured to the body. A hood is the heads of matches from any heat radiating from the stove. The other receptacle holds the ends of matches used to light the gas stove.

UMBRELLA STAND.—P. P. MCMENAMIN, Jersey City, N. J. The invention pertains to stands for umbrellas, canes and the like, and has reference more particularly to a stand comprising a frame formed to receive umbrellas or other like articles, and having a holder adapted to have the umbrellas rest against it in positions such that they can easily drain when wet, and out of engagement with one another.

Machines and Mechanical Devices.

COMBINED HOSE REEL, AUTOMATIC WATER DISCHARGER, AND FIRE ALARM.—A. A. HEIN, P. O. Box 108, Charleston, Wash. In this patent the invention shown in the illustration includes a fire hose-reel and attachments so constructed and combined that, when the hose has been drawn off the reel, a valve controlling discharge of water is au-



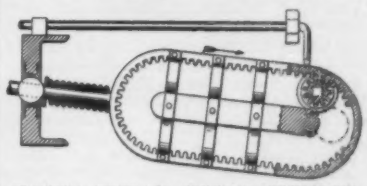
COMBINED HOSE REEL, AUTOMATIC WATER DISCHARGER, AND FIRE ALARM.

tomatically opened, and an alarm is also sounded automatically in one or more rooms in the building where the apparatus is located. It is simple in construction, easily operated by any unskilled person, and is particularly useful in hotels and lodging houses or wherever else it is necessary to give an alarm in a series of rooms or places.

DABBING BRUSH FOR WOOL COMBERS.—T. K. LEE, New York, N. Y. In machines of this type a pair of dabbing brushes are mounted diametrically opposite to each other, and the machine is constructed in such a way that the hank of wool to be combed is presented to the brushes, the wool being carried upon a horizontal circular support or wheel which is rotated by a step-by-step movement upon a central axis. Means provide for attaching the brush to its holder and the invention resides in the construction of the holder and brush.

Prime Movers and Their Accessories.

STARTING DEVICE.—JOHN P. LOONEY, Rural Free Delivery No. 1, Buckholts, Texas. The invention pictured herewith relates to starting devices particularly adaptable for internal combustion engines, and the aim is to produce a device for starting an engine by means of energy stored up by the said engine when



STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES.

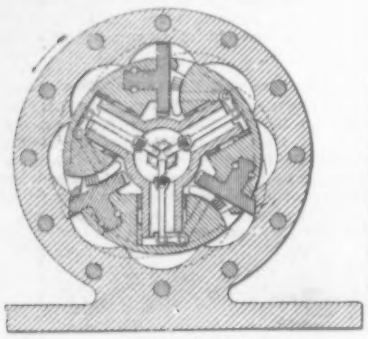
previously in operation. Use is made of a pinion for rigid attachment to one end of the shaft of an engine, an internally toothed rack operatively mounted on the pinion and provided with an extended rod in engagement with a spring, means on the rack for holding the pinion in an operative position relative to the rack, and means engaging the rack for connecting rack and pinion, to release the spring after the same has been substantially compressed.

COOLER FOR INTERNAL COMBUSTION ENGINES.—C. L. VAN SCHOICK, Milwaukee, Ore. The invention relates to cooling means for internal combustion engines, and more particularly to an improved tank adapted to be connected to the jacket of an internal combustion engine and operating automatically to withdraw the heated water from the jacket, cool it, and return the water to the jacket.

PISTON HEAD.—E. P. ROESCH, Douglas, Ariz. This invention is an improvement in piston heads and has for its purpose to provide a novel construction of what is known as the bull-ring by forming the said ring in two segmental sections fitted together around the body of the piston and receiving the snap rings by which the packing of the piston within the cylinder is secured.

ROTARY ENGINE.—JAMES H. WATSON, Box

88, Riverton, Wyo. In the present patent the object of the invention represented by the engraving is to provide a new and improved rotary engine, arranged to utilize the motive agent to the fullest advantage and to properly govern the speed of the engine. In order



ROTARY ENGINE.

to produce the desired result, use is made of a cylinder provided on its inner surface with spirally-arranged cavities for the motive agent to pass in, and a rotor mounted to turn in the said cylinder and having heads in the form of revoluble star wheels in mesh with the said cavities.

WATER GOVERNOR.—A. DICKERSON, American Fork, Utah. The invention of this patentee is more particularly intended for application to a pump to automatically control the same. A plunger is provided, having spaced, rigidly connected piston heads, the pump delivering to the cylinder between the heads of the plunger. Passages and suitable ports connect the space between the plunger heads with the adjacent ends of the cylinder in which the plunger moves, and valves are provided for controlling the ports. There is a connection between the governor and the valves for operating the latter, to simultaneously close the intake and open the exhaust to one end of the cylinder and produce the opposite effect at the other end of the cylinder, so that the entering fluid will shift the plunger. Suitable connections control the prime mover.

Railways and Their Accessories.

CAR COUPLING.—J. A. BEAMER, Tyrone, Pa. In car couplers of the Master Car Builders' type in which there are provided oppositely disposed hooks which interlock but hold the couplers together, there is no provision for lubrication except that of the locking mechanism and knuckle pin. The inventor contemplates lubricating the working faces of the coupler and so constructs it that this lubrication may be brought about with the minimem change in the contour lines, or least increase in the expense of manufacture thereof, and whereby all the rubbing or working faces will be lubricated from one source of supply.

CAR COUPLING.—W. S. LENNON, Tucson, Ariz. The purpose here is to provide means for releasing and opening the knuckle of a coupling of the Janin type, from a point near the side of a car whereon the coupling is placed; to provide a spring holder and means for detachably connecting the holder with the rear end of the coupling draw-bar, whereby the holder is adapted for quick detachment from the coupling, and its replacement facilitated, if it is accidentally broken or rendered insecure.

SAFETY DEVICE FOR RAILWAY TRACKS.—DR. R. E. CARLTON, Latonia, Ky., and M. W. RYLE, Balmorhea, Texas. The improvement is in guard rails for preventing derailing of cars. An object of the invention is to provide a device which may be advantageously used at points at which there is danger of derailment, such as on curves, or upon bridges, or other structures. A further object is to provide electrical means for notifying the operator if the derailment should occur and at what point.

Designs.

DESIGN FOR A TOY.—L. LEVY, New York, N. Y. This new ornamental design for a toy represents a rattan handle, at the top end of which is placed the head of a long haired French poodle, with a bow of ribbon around its neck. Three steamers, each tipped with a small bell, hang from the bow.

DESIGN FOR A KITE.—W. A. COLLINS, New York, N. Y. This design represents the form of a monoplane of the Antoinette type, and shows some detail of the framework. It is graceful, well balanced and successfully reproduces the aeroplane in a kite design.

DESIGN FOR A KETTLE AND STAND.—M. WEINTRAUB, New York, N. Y. This design of a kettle and stand is a beautiful work of ornamentation. Above the body of the kettle stands a scrolled handle, and the whole design including the four-legged stand, is covered with elaborate garden scenes with human figures, flowers, vines, heads, etc., in good taste and profusion.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE ROBINSON CRUSOE LIBRARY. New York: The Outing Publishing Company, 1909-1910. 16mo.; illustrated. The Book of Camping and Woodcraft. By Horace Kephart. 331 pp. Camp Cookery. By Horace Kephart, 154 pp. Backwoods Surgery and Medicine. By Charles Stuart Moody, M.D. 100 pp. Price, $4.

The editor of *Outing* selects these as three of the best outdoor books in America. From the outfit, and the details of camp life, to the treatment of wounds, fractures, and possible ailments, the whole field of life in the open has been covered, and its hardships and accidents robbed of their terrors. The little volumes may be obtained separately or, as quoted, enclosed in a heavy cloth case which makes of them a compact package. Travellers, campers, hunters, health-seekers, and mining engineers will all find in them companions in need with which they will be very unwilling to part.

THE AMERICAN SHOTGUN. By Charles Askins. New York: Outing Publishing Company, 1910. 8vo.; 321 pp. Price, $2 net.

From the shot-peppered cover design to the aphorisms which close the last chapter, this book will delight the devotee of the gun. His hands will itch to encircle the stock and barrel of some of the high-grade, richly-chased arms shown in the half-tones. The writer puts forward his subject matter in that hearty, zestful way so typical of the open-air man. He discusses the various makes, both foreign and American, in a fair, judicial manner and, aside from their points of construction, manages to impart much useful lore in regard to fitting the gun to the man; the care of the gun; the science of wing-shooting, and the psychology of the sport, with hints on the peculiarities of the different game birds, and a final word on field etiquette.

A MANUAL OF PRACTICAL ASSAYING. By the late H. Van F. Furman, E.M. New York: John Wiley & Sons, 1910. 8vo.; 530 pp.; illustrated. Price, $3.

Perhaps the best indication of the reception this work has been accorded is the fact that this edition is the seventh, making a total issue of thirteen thousand. Its revision and enlargement has been intrusted to William D. Pardoe, B.S. and A.M., who was formerly assistant in mineralogy at Princeton University. The chapters on the determination of silica, lead, copper, cobalt, nickel, and vanadium have been entirely rewritten, and a chapter on the determination or uranium has been added. Other additions worthy of mention are a description of the Pearce method for the determination of tin, the bromate method for antimony, a volumetric method for bismuth, and Neher's method for arsenic. The latter part of the volume is devoted to calculations and tables.

DESIGN OF MARINE MULTITUBULAR BOILERS. By James D. McKnight and Alfred W. Brown, A.M.I.Mech.E. New York: D. Van Nostrand Company. 8vo.; 48 pp. Price, $1.50 net.

For the benefit of marine engineers, marine draughtsmen, and students, who are without experience of boiler construction, the writers lay down, step by step, in simple form and language, the design of an average marine boiler, with the belief that the intelligent engineer or draughtsman will be able to follow them understandingly, and thus obviate the necessity of spending much valuable time on the boiler side in a shipyard draughting office, or may at least shorten the time materially.

ELEMENTS OF ELECTRICITY FOR TECHNICAL STUDENTS. By W. H. Timbie. New York: John Wiley & Sons, 1911. 12mo.; 556 pp.; illustrated. Price, $2 net.

The Pratt Institute classes have for a number of years been taught from the mimeographed notes upon which this text is based. Mr. Timbie regards the results as justifying the mode of presentation, although he admits this may not at all times be the usual mode, and that it may perhaps be open to the criticism of not being quite logical in its order. That it is teachable he avers the results demonstrate. A great deal of information is given in an immediately usuable form; this information is applied to substantial ends, not to abstract theory; it provides sufficient drill in practical problems to develop in the student a capacity for applying what he has learned; and it presents only what a technical student needs to know. History and generalities have been omitted. Thus a sure foundation is laid for more advanced courses.

A POCKET-BOOK OF MECHANICAL ENGINEERING. By Charles M. Sames, B.Sc. Jersey City: Charles M. Sames. 16mo.; 218 pp. Price, $2.

This digest, intended for the use of engineers and students, weighs but six ounces, and is brimful of useful formulas and valuable data and constants relating to the proportioning of machine parts, assembled machines, and motors. It is a fourth edition, brought down to date by revision and the inclusion of much new alloys and allowable fiber stresses, to aeroplane fundamentals and turbine design. Reinforced concrete construction, gearing, rope transmission, lubrication, steam boilers, hydraulic machinery, the cost of power and power plans, electrotechnics—all these topics, and many more, are discussed, with a wealth of information, tables, and diagrams that, considering the size of the book, is little short of wonderful.

THE YOUNG ELECTRICIAN. By Hammond Hall. New York: The Macmillan Company, 1910. 8vo.; 289 pp.; illustrated. Price, $1.50 net.

The author's aim is to afford "instructive amusement to intelligent boys." Starting with the early discoveries and the first principles of electrical science, he leads the reader on through the simple experiments of attraction and repulsion, of the electroscope and the Leyden jar, to such processes as electrotyping and electroplating, and to such devices as the telegraph, the dynamo, and the necessary equipment for wireless telegraphy.

A TEXT-BOOK OF PHYSICS. By H. E. Hurst, M.A., B.Sc., and R. T. Lattey, M.A. New York: D. Van Nostrand Company, 1910. 8vo.; 78 pp.; illustrated. Price, $3 net.

The preliminary examination in physics in the Oxford Natural Science School is the basis of this text-book. Examples are also introduced from the examination paper of Cambridge University, London University, and the Military Entrance Examinations. The source of the questions, and the year in which they were set, are indicated in brackets. Where there are several ways of working out a problem, the simplest has been given the preference. The divisions of the work are "Dynamics," "Heat," "Sound," "Light," "Magnetism," "Statical Electricity," "Current Electricity," and "General Physics." Diagrams, inserts, and full-page illustrations supplement and clarify the text.

DYNAMO ELECTRIC MACHINERY. Its Construction, Design, and Operation. By Samuel Sheldon, A.M., Ph.D., D.Sc., and Erich Hausmann, E.E., M.S. New York: D. Van Nostrand Company, 1910. 8vo.; 328 pp.; illustrated. Price, $2.50 net.

This is an eighth edition, completely rewritten, and considers only direct-current machines, alternating-current being dealt with in a second volume of uniform binding. This text-book is intended for the use of students pursuing electrical and non-electrical engineering courses, and the requirements of the classroom have been kept in view. The arrangement is such that those parts which students in the non-electrical course would not be required to study, may be passed over without disturbing the sequence of the remaining matter. From electrical and magnetic laws and facts, we pass to chapters on armatures, field magnets, generators, motors, and storage batteries. The final chapter is devoted to central-station equipment—outfit, installment, cost, selling price, and operating expense.

THE AUTOBIOGRAPHY OF AN ELECTRON. By Charles R. Gibson, F.R.S.E. Philadelphia: J. B. Lippincott Company, 1911. 12mo.; 216 pp.; illustrated. Price, $1.50 net.

This true fairy tale of the latest theory of science seeks to do for the electron what Ruskin, in his "Ethics of the Dust," did for the crystal. From the time when Queen Elizabeth's physician discovered what he thought to be the attractive properties of amber, down to the yesterday when proof of the existence of the electron revolutionized the mechanical theory of the constitution of matter, the tale logically and progressively unfolds from wonder to wonder. It should be in the hands of every boy; and there are few men but could read it with profit. It is when we read such narratives as this that we recognize the truth of Spencer's contention, the contention that science, properly studied, is a poetic, moral, and religious influence in the life of man.

THE STORY OF THE AMERICAN MERCHANT MARINE. By John R. Spears. New York: The Macmillan Company, 1910. 8vo.; 340 pp.; illustrated. Price, $1.50 net.

As a tale of glory departed, and as an inspiration to renewed and better-directed effort, this comes at an opportune time, when the nation is awakening to a sense of its loss. From "in the beginning," when the 30-ton seagoing pinnance "Virginia" was laid down in Maine for commercial purposes—the first vessel for such uses to be built in the United States—down through the years of early growth, of French spoilation, and of British aggression, to the period when steam entered the lists against sails and captured the trade from those who, unable to maintain their supremacy without it, were yet unwilling to put capital into what at first appeared to be a risky enterprise, the absorbing story runs on. With the advent of the "Great Britain" and the screw-propeller in 1844 came further need of the adoption of progressive methods. Still the American shipowner persistently clung to the paddle-wheel and the walking-beam. To this lack of initiative and this tenacity toward worn-out things, the author ascribes the downfall of American supremacy on the sea. The illustrations are no less interesting than the text. There are numerous full-page half-tones with such subjects as South Street, New York, in 1834; Captain Kidd's home at Pearl and Hanover Streets, 1691; clipper ships, pilot-boats, modern schooners and brigs, and the liner "Lusitania." Mr. Spears, in attributing our by-gone supremacy primarily to the efficiency of the American sailor, insists that the Stars and Stripes can never regain their place upon the high seas until the times shall evolve "a nautical unit as efficient for these modern days as was our ship of the sail in days long past."

PRINCIPLES AND DESIGN OF AEROPLANES. By Herbert Chatley. New York: D. Van Nostrand Company, 1911. Pocket Size. Price 50 cents.

Prof. Herbert Chatley's latest work, "Principles and Design of Aeroplanes," might have passed as fair ten years ago, but in the light of the increase in knowledge of aviation during the past few years, it is very inadequate. At present there are several Farman types, the H. Farman, M. Farman, etc., but in this book "Mr. Farman's machine," referred to at great length, is none other than the old 1907 Voisin, and Prof. Chatley states that the majority of *successful machines of to-day* are of this type. The warping of the planes on the Wright machines is described as "twisting one of the planes so that the *forward* edge goes upward on one side of the center and downward on the other"; whereas the manner in which the front of a Wright machine remains perfectly rigid and the rear ends of the two planes moved, is now common knowledge. The frontispiece, entitled "General Principles of the Aeroplane," represents a flat-planed affair with two revolvable planes at the front serving, evidently, as a rudder; between them is seated the "aeronaut." A steering plane is at the extreme front, and a queer-looking propeller at the rear, just in back of the two rear surfaces that are labeled "usually immovable." What "general principle" is this supposed to represent is certainly an enigma. In the discussion of theoretical matter no explanations of the action of cambered surfaces or of the movement of the center of pressure are given. A typical example of the absurdity of the entire book is the following: "The system introduced by Mr. Chanute of a longitudinal girder crossed by two transverse frames supporting the planes is rather fragile when the weight is limited as at present, and Langley's frame is but little stronger. In fact, the late professor's man-carrying machine came to grief (owing to collapse of guide rails) before flight." Confusing statements of this sort are worse than worthless. Another choice specimen is this: "If a plane touches any obstacle during the flight, there is almost certain destruction of the whole machine. For this reason it seems desirable to reduce the speed." No doubt we shall soon have "narrow-gage" aeroplanes designed to fly through tight places! A refreshingly amusing paragraph is the following: "The plane has to carry, in addition to its own weight, that of the prime mover and the propeller, together with other small items, such as aeronauts."

The continual use of the word "aeronaut" instead of the more usual "aviator" is to be condemned.

THE BOOK OF WHEAT. By P. T. Dondlinger. New York: Orange Judd Company, 1908. Small 8vo.; 369 pp. Price, $2.

The subject treated in this work is one which appeals not only to the special interests of several classes, the producer, the merchant, the speculator, but also to the consumer, that is to say, the general public. The book deserves high praise for the lucid and attractive manner in which the many phases of the subject are presented. The author takes up first the biological side of his topic, dealing with the origin of wheat, the classification of different varieties and their geographical distribution, and the life cycle of the plant. A consideration of the physical and chemical properties of the wheat plant and especially the grain conclude the first chapter. The second chapter is devoted to the "improvement of wheat" by scientific breeding. Chapter III deals with the influence of environment. This might be said to complete the more strictly biological portion of the book. With Chapter IV we enter into the consideration of the several operations incident to the wheat-farming industry, the cultivation and harvesting (Chapter V) of the crop. The ensuing chapters deal with yield and cost of production, crop rotation and irrigation, fertilizers, and diseases of wheat. Chapter II might be said to be the first of those dealing more specifically with the economic problems of wheat production. These chapters make exceedingly interesting reading. Then are considered in order the subjects of transportation, storage, and marketing. The last chapter of this section is entitled "The Price of Wheat" and gives among other things a lucid exposition of the rational and economic effects of the machinery of speculation, which is shown to fulfil a distinctly beneficial function. The remaining chapters are devoted to the milling of wheat, and its consumption, production, and movement. An appendix gives a detailed classification on the decimal plan of the principal species and varieties of wheat, indicating their essential characteristics and geographical distribution. There is a most excellent bibliography covering some 32 pages of small print, and lastly a good index.

The book bears every mark of good authorship and publisher's technique, and is warmly recommended to all interested.

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(*Continued from page 244.*)

is quieter and smoother; control is simpler and easier; while the handiness of the bus in crowded traffic is much greater than with the usual vehicle. So quickly can it be stopped with the powerful brakes that, when running at twelve miles an hour, it can be brought to a standstill in from twelve to fifteen feet. The control being so simple, less physical exertion is imposed upon the driver, as the vehicle is controlled practically upon the throttle of the gasoline motors. A complete breakdown is almost impossible as the vehicle can be driven either on the electric or the gasoline motors, and by one engine if necessary. Should it be necessary to overhaul an engine this can be taken out and a reserve one substituted within thirty minutes. All parts of the mechanical equipment are readily accessible. Although the center of gravity is low, thus reducing the risk of overturning, greater clearance between the ground and the under side of the vehicle is secured, and should a person unfortunately be knocked down, by lying prone he can let the vehicle pass over him safely.

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The Soap-nut Tree

A Valuable Addition to the Products of American Soil

By E. Moulié

IN this article Mr. Moulié presents a résumé of the situation and prospects of the soap-nut industry, in the introduction of which to this country he has with much generosity taken an active part. At the same time he makes another offer to further the new industry by supplying to persons seriously interested a quantity of seeds out of his own resources.—EDITOR.]

The original introduction of the soap nut tree into this country is to be accredited to the Rev. Benjamin Helm, a missionary, who brought some seeds from China about twenty-seven years ago. From these seeds only one fully developed tree is in existence and this is in the possession of Mr. J. A. Livingstone, of Okla, Fla. A report was published some time ago by Mr. Kidder, United States Consul at Algiers, at the instigation of the writer, dealing with the economical value of the soap nut tree. At that time (1905) the value of the solitary seed-bearing soap nut tree in this country was not known to its possessor. To-day he is satisfied that he has therein an extremely profitable asset.

INTRODUCTION OF SEEDS.

At the beginning of 1905, after reading the report of the American Consul, the writer imported seeds from Algiers and distributed them free to persons interested. Every year since that time he has bought from Mr. Livingstone all the seeds that the latter could spare, which meant nearly the whole of his crops, and has made a gift of them to all the people of all the Southern States, and also of nineteen foreign countries, in which that tree can be raised and brought to full development. It is a conservative estimate to place the number of trees now growing in Florida at 500,000. In Jacksonville and Duval County alone there are not less than 100,000.

This movement attracted the attention of Mr. David Fairchild, of the Bureau of Plant Industry, Department of Agriculture, who took a great interest in the work, and raised its scope to national importance when he imported seeds from China for free distribution. Some of these also have found their destination in Jacksonville. The writer does not know precisely what number of seeds were distributed by the Government.

THE USEFULNESS OF THE TREE.

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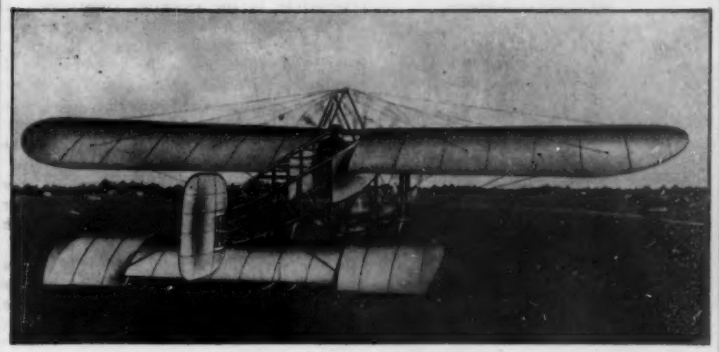

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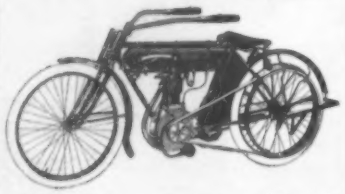

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that the fruit (soap nut) and the kernel of the seed furnish the raw materials for a score of toilet articles of very considerable commercial value. In the preparation of those products in which the saponaceous principle is the essential constituent, the hull of the seed supplies the raw material. The kernel contains no saponaceous matter, but furnishes a fixed oil which for culinary purposes is equal, and in the estimation of some even superior to olive oil. The oil can also be used for making a soap that will easily compete with the best imported Castile soap.

The soap nut has also a certain therapeutic value. Its medicinal virtues, according to reliable authorities, are thus described:

The soap nut is used internally in cases of salivation, epilepsy, and as an expectorant. The seeds, pounded with water, are said often to put an end to a paroxysm of epilepsy, when a small quantity is introduced into the patient's mouth. The fruit is also recommended by native practitioners for the cure of chlorosis.

The Leaves and Wood.—The leaves make a good fodder, and the cakes from the press after the oil is extracted from the kernel, are relished by poultry and all kinds of stock.

The wood is close-grained, takes a good polish, and is admirably adapted for furniture. In color it resembles orange wood. Considering that the soap nut tree grows to a height of fifty feet when fully developed, it will be seen that it presents a very valuable source of timber. In point of fact, however, in the native land of the tree the wood is not used, the income from the fruit and leaves prohibiting the cutting down of the tree, the returns from the fruit in its raw state alone being $10 to $20 per tree every year.

SOAP MANUFACTURE.

It is no secret to those interested in the industry of soap manufacture, that cottonseed oil is almost beyond the reach of the soap manufacturer owing to the market conditions affecting the price of that material; hence the prediction which the author made when he inaugurated the movement of the soap nut tree industry, that the time would soon come when the soap nut would be in demand for the soap industry. That prediction has come true much sooner than was expected, as Mr. J. H. Livingstone, of Okla, Fla., has received several inquiries and quotations for the soap nut in carload lots, to say nothing of the inquiries of which the writer has himself been the recipient.

The cost of production of the soap nut is practically nil, once the trees are well started. The growing of cotton, on the other hand, is expensive and the production has to be restrained to a certain limit in order to preserve the commercial equilibrium between demand and supply; overproduction of cotton means low prices and consequently heavy losses and discouragement to the producers who have been put to very considerable expense in raising their crops. The situation is somewhat different as regards the soap nut trees, since the production costs practically nothing and in the most unfavorable case the timber of the tree represents a very substantial source of income to fall back on, in any emergency which might be imagined to arise.

FOAM PRODUCING QUALITIES.

The efficiency of the soap nut extract as a foam producer, which renders it so valuable not only in soap manufacture but in certain other applications, is discussed in *Pure Products*, from which some passages may here be quoted:

"Saponin extract has various uses, as an addition to toilet soaps and other toilet preparations, for example, and also as foam producing ingredient in carbonated beverages. As compared with Panama bark, which has heretofore been the principal source of saponin, the soap nut has a decided advantage, the yield of saponin being nearly four times as great from the soap nut as from the Panama bark. The foam of the soap nut is more close-grained, and considering that the cost of the two raw materials is about the same, the hulls, if obtained in sufficient quantity should have no difficulty in driving the bark out of the market.

"It is said that the soap nut is also used by chemical laundries and cloth fullers in place of soap.

"If ever the soap nut becomes a commercially important product in Florida, the seeds, being necessarily a by-product, will have more or less value as a source of oil; the oil made therefrom resembles peanut oil in its general composition."

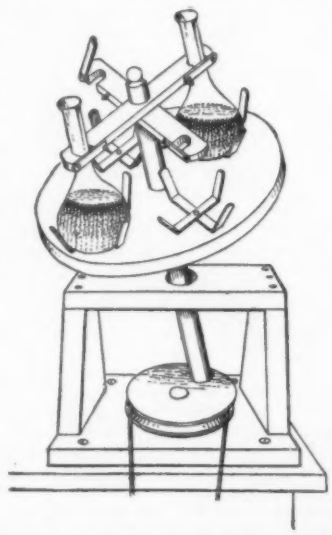
ANOTHER FREE DISTRIBUTION OF SOAP NUT SEEDS.

I have a great many thousands of seeds which I intended to use for the oil, but considering the intense interest manifested in favor of the development of the tree, and realizing that a greater good would materialize by the planting of these seeds, I have decided to give them away to applicants who are owners of land on which the seeds may be planted, and who will consider themselves honor bound to make all possible efforts toward success. My offer covers States or parts of States in this country in which the citrus fruit can be raised, excluding Florida, since Florida is already amply provided for. There are about twenty seeds to the ounce; every applicant can have as many ounces as he or she wishes for one cent an ounce to cover the postage; the seeds are free, but an extra five cents must be added to cover the expense of a cloth bag, time and clerical work, as well as the printed directions for planting which are accompanied with illustrations of the soap nut. Applicants must write their name and address plainly at the upper left-hand corner of the envelope and address their application as follows: E. Moulié, Jacksonville, Fla. Orders will be filled at once. Applicants should hurry as the season is from now on until May.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12401) N. D. L. asks how to make a power mixer for liquids in Florence flasks. A. Try a device like that shown. The construction will be readily understood, and the device can be rigged up by any amateur mechanic. The Florence flasks should be well secured in place as the power of the machine is quite considerable.



(12402) G. B. asks: A says that a rifle ball having a velocity of 60 miles per hour, fired from a rifle, on rear platform of a train of same speed, in opposite direction of motion of train, will drop to ground upon leaving barrel of rifle. B says it will fly practically as far as if fired by person standing on ground. Who is right, and why? A. A rifle ball fired from a moving train in a direction opposite to, and with a velocity the same as that of the train, goes by the force of the powder as far as it would go if shot by a man at rest upon the ground and in the same direction. But it has also the motion of the train when shot from the moving train. As this is equal and opposite to that produced by the powder, it follows that the ball has two equal motions and opposite in direction, so that the one just balances the other, and as A says, the ball would seem to fall from the mouth of the gun to the ground if it could be fired in such a manner. It might be done with a base ball if thrown with the proper force by an expert pitcher. It could not be done with a rifle, since the muzzle velocity of a rifle is much more than a mile a minute.

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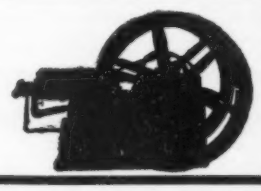

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Electricity

Electric Freight Service.—The Fort Dodge, Des Moines and Southern Railway has decided to use electric locomotives hereafter for the operation of freight trains. The locomotives will each be capable of hauling fifteen to twenty cars.

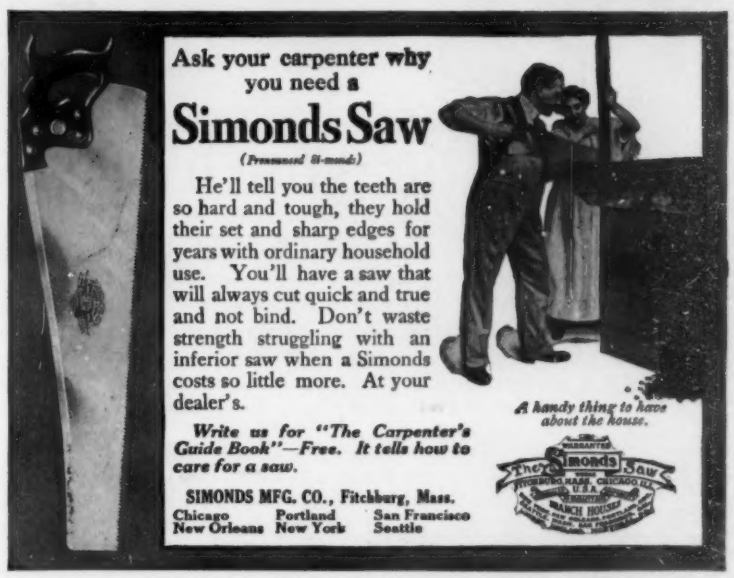
Tests for Insulating Tape.—Writing in a recent number of the *Electrical World*, Mr. William P. Munger calls attention to the fact that there have not appeared adequate specifications and tests for friction tape. He names six qualities for which standard tests should be set: 1. Insulation, the property for which tape is used. 2. Character of compound, a quality often neglected. 3. Adhesiveness, which mainly determines the life of the joint. 4. Mechanical strength, important mainly from the workmen's viewpoint. 5. Feet per pound. 6. Durability.

Tungsten Lamps in a Factory.—An automobile factory in Detroit has been equipped with fifteen hundred 60-watt tungsten lamps. The factory was not completely equipped when the lamps were installed, and owing to constant jars, it was thought that the lamps would be constantly failing. However, it was found that the renewals required were but 1.8 lamps per day for a period of 75 days. When a filament was broken, the lamp was given a slight tap so as to set the filament swinging, and this would ordinarily result in bringing the broken ends together and causing them to fuse. At times a lamp with as many as three filaments broken was saved in this way.

Fire Extinguisher for Electrical Apparatus.—The problem of fighting fires in and about electrical apparatus is a serious one owing to the fact that the water, if water be used, is liable to damage insulation and cause corrosion of the metal parts. Sand is usually considered a better material to put out incipient fires. What is needed is an extinguisher that is a non-conductor and one that will not attack metals or insulating materials. Recently the production of carbon tetrachloride has been rendered comparatively inexpensive. The liquid is very volatile and its vapor is an excellent fire extinguisher. Furthermore, it does not attack the conductors or insulating materials used in electrical apparatus.

Electrification vs. Smoke in Chicago.—An investigation has recently been made of locomotive smoke in Chicago in order to determine what share of the smoke in the city comes from this source, and to show that by eliminating steam locomotives and substituting electric locomotives, there will be a decided abatement of the smoke nuisance. Mr. Paul P. Bird, the city smoke inspector, has collected some very startling statistics. He estimates that fourteen car loads of cinders pour out of the locomotive smokestacks at Chicago every day, that 10 per cent of all the coal shoveled into the firebox of a locomotive issues from the stack in smoke and cinders, that railroads contribute 43 per cent of the total smoke in the city, power plants 30 per cent, and special plants 12½ per cent, while the smoke from business buildings and dwellings, and from boats, amounts to but 14½ per cent.

Fool-proof Devices.—In order to make his storage battery absolutely fool-proof, Mr. Thomas Edison devised a machine for abusing the battery in every known way, but although he is one of our most brilliant inventors, Mr. Edison had to admit that when it came to inventing methods of abusing electrical apparatus, he could not compete with the "fool" operator. Try as he would to forestall every conceivable method of injuring the apparatus, some stupid man would devise a new and unthought of method for putting it out of business. In this connection, it is interesting to note that a discussion on fool-proof devices was held before the West of Scotland branch of the Association of Mining Electrical Engineers. One of the speakers argued that it was unnecessary to attempt to make apparatus entirely fool-proof, and that it was bad practice to surround electrical gear with devices and safeguards which would interfere with the action of the trained engineer. Another speaker pointed to that the fact that there are not as many fool operators as one would imagine; that the so-called "fool" is an ignorant man, and that it would be better to educate him than to prevent him from doing injury to himself or to machinery by means of safeguards, while permitting him to remain ignorant.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NOTICE TO CONTRACTORS.

Sealed proposals for Electric Generating Plant, and for Feeders and Transformers; Series Outside Lighting; Motors; and Power House Lighting, at Hudson River State Hospital, Poughkeepsie, N. Y., will be received by the State Commission in Lunacy, Capitol, Albany, N. Y., until 3 o'clock, P. M., on Wednesday, March 15th, 1911, when they will be opened and read publicly.

Proposals shall be accompanied by certified check in the sum of $800 for Electric Generating Plant, and $1000 for Feeders and Transformers, etc., and the contractor to whom either award is made will be required to furnish Surety Company's bond in the sum of $10,000 for Electric Generating Plant, and $10,000 for Feeders, Transformers, etc., within thirty days after notice of award of contract and in accordance with the terms of specification No. 1408. The right is reserved to reject any or all bids.

Drawings and specifications may be consulted and blank forms of proposal obtained at the Hudson River State Hospital, Poughkeepsie, N. Y., and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the State Architect, Franklin B. Ware, Albany, N. Y.

T. E. McGarr, Sec'y, State Com. in Lunacy.
Dated: Albany, N. Y., Feb. 28, 1911.

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How do you like the Scientific American?

¶ The problem of editing the *Scientific American* is more difficult than the thousands of readers who receive it every week may realize. In presenting the scientific and industrial news of the day accurately and interestingly, it goes without saying that discrimination must be used. Is this invention or that discovery of sufficient importance to find a place in a periodical which is intended primarily for business men, inventors, doctors, lawyers, and a host of professional men, men of broad views and intelligence, men who want to be kept abreast of the scientific times? Or is it simply a little ripple on the great ocean of human thought, something that we can ignore? Or is it so curious that it will interest a host of readers by its sheer novelty rather than its scientific value? Over and over again these questions must be answered during the year.

¶ Of course, the editor is a human being and has his likes and dislikes. Perhaps battleships, flying machines, radium, and the everlasting stars interest him so much as a man that unconsciously he has permitted his editorial self to drift away from the standards which some readers would have him follow. If so, he would like to receive well-meaning letters that show how readers of the *Scientific American* regard the periodical.

¶ Why not tell the editor what you think of the *Scientific American*? Tear the paper to pieces if you like. Begin with any issue, with the year 1845, when it was first started, if you care to, and wind up with the last number. Show us where we have succeeded in pleasing you and where we have failed. Tell us something about your tastes, something about your calling in life, and why it is that certain articles interest you more than others. If there is anything in the pages of the *Scientific American* that seems too deep for a layman, too technical in a word, although the subject itself may appeal to you, tell us so. If there are some subjects which have been discussed too often or too little, tell us what they are.

¶ What do you think of transferring the weekly list of patents granted, to the columns of the *Scientific American Supplement*? Is or is not the reading matter now printed in its place of more interest and value to you?

¶ In order to show you how much space the *Scientific American* has been devoting to science, industry, mechanics and engineering in the past year, we publish here an editorial chart which will help you, a chart which will show you at a glance how many columns have been devoted in the year to steam engineering, to physics, to naval affairs, to meteorology, to bridges, to astronomy and aeronautics. We compiled this chart to help ourselves, and now that we have done so we feel that it may help you as well.

DATE 1910	Aeronautics	Agriculture	Archaeology	Astronomy	Automobiles	Biography	Biology	Botany	Bridges & Canals	Building Construction	Chemistry	Civil Engineering	Correspondence	Electricity	Exploration & Travel	Fuels	Gas Engines	Irrigation	Mechanical Engineering	Manufacturing	Mechanics	Medical	Meteorology	Mining & Metallurgy	Miscellaneous	Natural History	Naval Matters	Ordnance & Armor	Photography	Physics	Railways	Sanitary Science	Science	Steam Engineering	Subways & Tunnels	Notes & Queries	Books
January 1	3	–	–	3	–	¾	–	–	–	–	–	1	1½	3½	6	–	–	–	–	–	–	5	–	–	5	–	–	–	1½	–	1	6	½	F	1	–	1	½
" 8	7	–	–	½	–	–	–	3	–	–	2	1	½	3	–	–	–	–	–	–	1½	–	–	½	3	–	–	–	1	6	½	1	1	–	1	1	
" 15	–	–	–	–	62	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	½	3	–	–	–	–	–	–	–	1	1	–	1	
" 22	3	3	–	–	–	–	–	–	–	–	–	8	3	3	–	–	3½	–	–	–	–	–	–	–	2	1	–	–	–	4	1	–	1	1	–	1	4
" 29	6	–	–	7½	–	–	–	–	2	–	–	1	1	1	–	–	–	–	3	–	–	–	–	–	3	3	–	–	–	–	–	–	1	–	–	2	4
February 5	–	–	–	3	–	–	–	–	–	–	–	3	3	1	–	–	–	–	–	–	4	2	–	–	4	1	7	–	–	2	–	–	1	–	–	6	4
" 12	1	–	–	10	–	–	–	–	4	–	–	3	1½	1	–	–	–	–	–	–	–	–	–	–	3	–	6	–	–	–	–	–	1	–	–	–	4
" 19	1½	–	–	1	–	–	–	–	3	–	–	4	2	1½	9	–	–	–	–	–	–	–	–	–	4	–	5	–	–	–	–	–	1	–	–	–	3
" 26	–	2	–	–	–	–	–	–	–	–	–	1	1	4	–	–	–	–	–	–	–	–	–	–	3	4	3	1½	–	8½	–	–	1	–	–	–	–
March 5	1	4	1	–	–	–	–	–	4	–	–	1	1	1	–	–	1	–	–	–	1½	–	3	–	3	–	5	3	–	–	–	–	1	–	–	1	–
" 12	1	–	10	4	2	–	–	–	–	–	–	3	1	3	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	1½	–	–	1	–	–	1	1
" 19	4	–	–	–	–	–	–	–	7	–	1	7	–	5	–	–	–	–	–	–	–	–	–	–	2	2	9	–	–	–	1	–	1	–	–	–	–
" 26	–	–	–	2	–	–	–	–	1	–	–	2	–	1	–	–	–	–	–	–	–	–	3	–	6	5	2	–	6	–	4	–	1	–	–	–	–
April 2	–	–	2	–	1	–	–	–	–	–	–	12	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	1	–	–	1	–	–	3	3
" 9	–	–	–	3	5½	½	–	–	3	–	–	1	2	4	½	–	–	–	–	–	3	–	½	–	3	–	–	6	2	–	–	–	1	–	–	–	–
" 16	–	–	–	1	–	–	–	1	–	–	–	4	3	2	–	½	–	5	–	–	1	–	–	–	4	–	–	½	–	2½	–	–	1	–	2	1	2
" 23	5	–	–	3	–	–	–	–	1	–	–	1	1	2	–	–	4	–	–	–	–	–	–	–	3	5	4	–	–	3	–	–	1	–	–	–	–
" 30	–	3	–	1	–	–	–	2	–	5	6	2	1½	1	–	–	3	–	–	–	3	–	–	–	3	–	–	–	–	6	–	–	1	–	–	1	–
May 7	5¼	–	–	3	–	–	–	–	–	–	–	5	2½	1	1½	–	1	–	–	–	–	–	–	–	3	6½	5½	–	–	–	3	–	1	–	–	–	–
" 14	4	–	–	4	–	–	–	–	–	–	–	1	–	4½	–	1	4	–	–	–	6	–	–	–	2	3	–	1½	–	14	–	–	1	–	–	1½	5
" 21	1	2	–	2	–	–	–	–	1	–	–	1	–	4	–	4	–	–	–	–	–	–	–	–	3	1	3	–	–	–	–	–	1	–	–	2½	2
" 28	1	–	–	4½	–	½	–	–	–	–	2	2½	–	1	3	½	3	–	–	–	–	–	–	–	3	–	½	–	6	4	–	–	1	4	–	–	½
June 4	–	1	–	–	–	5	–	–	–	–	5	1	–	3	2¼	–	–	–	–	–	–	–	–	–	3	–	4	4	1½	–	–	–	1	4	–	1	1
" 11	13	–	–	1	–	3	3	–	5	–	–	1	–	1	–	–	–	–	–	–	6	–	–	–	2	2	–	–	–	–	–	–	1	–	–	1	3
" 18	6	–	–	7	–	–	–	–	1	–	–	–	1½	4	–	–	–	–	–	–	–	–	1	–	2	3	–	–	2	–	–	–	1	–	–	–	2
" 25	11	–	–	1	–	–	–	–	–	–	1	4	–	6	–	–	–	–	–	–	–	–	5	–	4	–	2	–	–	–	3	–	–	–	–	2	2
July 2	6	–	–	3	–	½	–	–	–	–	–	5	–	3	–	–	–	–	–	–	–	–	–	–	5	6	–	3	–	–	–	–	1	–	2	2	2
" 9	3	–	–	–	–	–	–	–	7	–	–	10	1	4	–	–	–	–	–	–	2	–	–	–	8	–	½	–	1	–	–	–	1	–	3	1	2
" 16	6	–	–	2½	–	½	–	–	–	5	–	1	2	1	–	–	–	–	–	–	–	4	–	–	4	–	–	4	6	–	–	–	1	–	3	2	1
" 23	8	–	–	–	3½	–	–	–	–	–	–	4	–	2	–	–	½	–	–	–	–	–	7	–	4	2	–	4	½	–	–	–	1	–	3	–	–
" 30	10	–	–	2½	5	–	–	–	–	–	–	2	–	4	–	–	–	–	–	–	–	–	–	–	2	–	1	7	–	–	–	–	1	–	3	1	1
August 6	3	–	–	–	–	–	–	–	–	5	–	–	–	3	4	–	–	–	–	–	6	4	–	–	6	5	–	2	–	–	–	–	–	–	10	½	1
" 13	14	–	–	–	–	–	–	6	–	–	–	2½	1½	–	–	–	–	–	–	–	–	–	–	–	8	½	½	–	–	–	–	–	–	–	2½	1	1
" 20	2½	–	–	–	–	–	–	–	–	–	–	7	1	1	3	–	–	–	–	–	–	–	–	–	9	–	5	–	–	–	–	–	–	–	–	1	1
" 27	4½	–	–	3	–	1	–	3	–	–	3	3	–	–	–	–	–	–	–	–	–	–	–	–	2	4	7½	–	7	4	–	–	1	–	4	1	1
September 3	5	–	–	6	–	–	–	–	–	–	–	4	3	–	1	–	4	–	–	–	3	–	1½	–	6	–	–	–	–	–	–	–	1	–	2½	1	2
" 10	7	–	3	½	–	1½	–	–	–	–	2	–	–	1½	1	–	–	–	–	–	–	–	–	–	2	3	½	1	–	8	–	–	–	–	2	1	1
" 17	9	–	–	–	–	–	–	–	–	–	–	4½	–	3	–	–	–	–	–	–	6	4	–	–	4	3	–	–	–	–	½	–	1	–	2	1	1
" 24	2	–	–	–	1	–	–	–	½	–	–	2	2	1	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	–	5½	1	5	1½	1	–
October 1	9½	–	–	6½	–	–	–	–	–	–	–	5½	2	1	–	–	–	–	–	–	3	–	–	–	7	–	1½	–	2½	–	3	–	–	–	–	1½	–	–
" 8	7	–	–	–	4	–	–	–	–	–	–	–	2	4	–	–	–	–	–	–	–	–	–	–	6	–	10	½	–	3	–	–	1	–	–	1½	–	1
" 15	2	–	–	3½	3	–	–	–	–	–	1	4	1	–	–	–	–	–	–	–	–	6	–	–	2	–	–	3	–	7	–	–	1	–	6	½	1
" 22	39	–	–	–	–	–	–	–	–	–	–	–	2	2	–	–	–	–	–	–	–	–	5	–	2	–	–	–	–	–	–	–	1	–	–	½	3
" 29	43½	–	–	3	2½	–	–	5	–	–	–	1	–	–	½	–	–	–	–	–	–	–	–	–	7	–	–	–	3	–	–	–	1	–	1½	1	1
November 5	15½	–	–	2½	–	–	2	–	–	–	–	–	–	8	–	–	–	–	–	–	–	2	–	–	2	–	–	3	–	3	–	–	1	–	–	1	1
" 12	13½	–	–	½	–	–	–	–	–	–	–	–	2	1½	–	–	–	–	–	6	–	–	–	–	6	–	6	–	3	2	–	–	1	–	–	1	2
" 19	3½	–	–	10	–	–	–	–	–	–	6	5	1	1	–	–	–	–	–	6	–	–	–	1½	2	–	1½	–	4½	–	1	1	–	2	1	
" 26	7	–	–	2	–	–	–	–	6	–	1	–	–	1	1	–	–	–	–	–	–	–	–	–	2	–	–	5	–	–	–	–	1	–	–	–	
December 3	2	8	–	3	1	–	3	–	–	–	2	–	–	4½	–	–	–	–	–	–	–	–	–	–	6	–	–	–	–	–	2	6	1	–	–	–	
" 10	5	–	–	–	3½	1	–	–	–	–	–	13	1	1	–	–	–	–	–	–	–	–	–	–	3	–	2	–	–	–	–	2	–	4	–	–	
" 17	4	–	–	–	–	–	–	–	–	–	–	–	1½	1	–	–	–	–	–	–	6	–	–	–	4	–	5	–	4½	–	–	–	1	6	3½	–	
" 24	8	½	–	–	–	–	–	–	–	2	–	1	–	9	–	–	–	–	–	–	1	–	–	7½	4	3	10	–	–	–	–	–	1	–	–	–	
" 31	3	–	–	3	–	–	–	–	4	–	2	2½	–	2	–	–	–	–	–	–	–	–	–	–	9	3	–	–	–	–	–	–	–	–	–	–	
	404	43	16	128	93	164	8	20	48	18	94	160	52	112	28	6	24	5	3	23	63	20	7	24	130	37	111	37	49	47	62	12	53	20	61	44	61

¶ After all, every periodical is the product of its readers as much as of its editors. It is the letters that we receive in the morning's mail, the little straws that show which way the wind is blowing, that guide us as much as our own thoughts, in publishing this journal. The more expressions of opinion that we receive the better able are we to perform our task.

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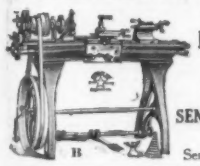

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Mammoth Whistles for a Mammoth Ship.—The steam whistles for the "Olympic," the largest ever made, consist of three bell domes 9, 15, and 12 inches in diameter, with a maximum height of 4 feet 2½ inches. One set will be carried on the forward funnel and another on the second forward funnel.

Catskill Aqueduct Tunnel.—The Board of Water Supply in New York city will shortly let a contract for constructing a large syphon tunnel beneath the Hudson River at Storm King to carry the water supply to the eastern side of the river. Borings indicate that to reach a sufficiently firm unfissured rock, the tunnel must be carried to a depth of over one thousand feet below the surface of the river.

Quebec Bridge Experts.—The Quebec Bridge Board has developed serious differences of opinion as to the merits of the plans submitted in response to its call for bids. To assist in reaching a conclusion, the Canadian authorities have appointed as additional experts Mr. Henry W. Hodge, Consulting Engineer of New York city, and Mr. M. J. Butler, General Manager of the Dominion Iron and Steel Company, of Sydney, Nova Scotia.

Proposed Ocean Terminal at Montauk.—The recent purchase by the Long Island Railroad of one and a half miles of water front at Montauk Point, at the easterly end of Long Island, seems to give point to the many rumors that the Pennsylvania Railroad Company proposes to build a trans-Atlantic steamship terminal at this place. Should the liners land here, a two-hours' railroad run would place the passengers in the heart of Manhattan Island, with a saving in time of five or six hours.

New York Subway Traffic.—As reported to the Public Service Commission, the sale of tickets shows that in 1910 the New York subway carried 270,321,490 passengers. In 1905, the first year of operation, its sales were considerably less than one-half of this, amounting to 116,209,313. Last year, the largest sales, 16,688,028, were made at the Brooklyn Bridge station. The Borough Hall, Brooklyn, sales were 15,900,312. The Grand Central station and Fulton Street, Manhattan, sold each over 13,000,000 tickets, Fourteenth Street, over 12,000,000, and Times Square, over 11,000,000.

We Must Fortify the Panama Canal.—Of all the arguments for fortifying the Panama Canal, the most potent is that recently presented by President Taft, when he drew attention to the fact that a very considerable proportion of the nations of the world have not yet progressed to the point where they have at all times stable, reliable and responsible governments. Incidentally, we might mention that the two most powerful dreadnoughts in the world were for a time in the hands of mutineers in the navy of a South American republic. One of these ships, regardless of international agreements as to neutralization, could easily have destroyed the finished canal.

Railroad Accidents in the United States.—The Interstate Commerce Commission Accident Bulletin, covering the three months ending September 30th, 1910, gives the number of persons killed in train accidents during that period as 321, and the number injured as 3,392. Other accidents, such as those to employees, to passengers getting on or off cars, accidents at grade crossing, to trespassers on the tracks, etc., bring the total up to 2,948 killed and 19,380 injured. This is at the rate of nearly 90,000 casualties a year. On the other hand, Harriman's system or railways has recently announced that it carried 50 million passengers in 1910 without a fatality. This, we presume, relates to train accidents, pure and simple.

The Pintsch Gas Explosion at the Grand Central Station.—Professors Lucke and Monroe, after examining the scene of the Pintsch gas explosion at the Grand Central Terminal, New York, have decided that the pressures required to bend the floor I-beams and blow out the northerly walls might easily have been developed by a gas explosion. A mixture of Pintsch gas with air is explosive within a gas percentage range of 5 to 13 per cent, and it develops its maximum power at about 9 per cent. The gas leak and other conditions were sufficient to produce a thorough mixture of gas and air of the maximum explosive power; and a flame, spark or glowing surface, within the range of the explosive mixture and within or without the building, would have sufficed to ignite the whole.

Science

Modern French Time.—For more than a quarter of a century an effort has been made to do away with the difficulties caused by referring time to two meridians—Greenwich and London. France has decided to adopt the Greenwich meridian hereafter. The Greenwich meridian is the one generally used in astronomical calculations.

Natural and Artificial Vichy.—Natural Vichy water always contains salts of lithium which are not present in artificial vichy. The spectrum of lithium is characterized by a bright red line. Hence the genuineness of a specimen of water sold as vichy can be proved or disproved by evaporating a few fluid ounces of water to dryness, heating the solid residue to incandescence in a Bunsen flame and examining the flame with a spectroscope. If the red line characteristic of lithium does not appear, the water is artifiial.

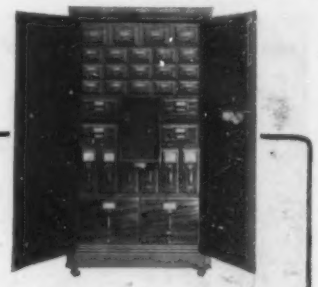
The Recent Election in the Academie des Sciences.—There was a considerable stir among academic circles in Paris owing to the fact that both Prof. Edouard Branly and Mme. Curie were candidates for the vacant seat in the Académie des Sciences. A complication lay in the proposition of admitting women as members of the Academy, hence there was a prolonged discussion upon this point. As both the candidates occupy a leading position in the scientific world, each had many partisans. At the election, Prof. Branly received 30 votes and Mme. Curie 28, so that Prof. Branly was thus elected.

A Recently Discovered Variable Star.—M. Deslandres, a well known French astronomer and chief of the Meudon observatory, brings out some new points about a variable star in the constellation of the Lizard. This star, which was discovered about a year ago, seemed at first to be of the 12th or 13th magnitude. Its brightness suddenly increased, and during last November it reached the 5th magnitude. Less than a month after, its brilliancy lessened, and now the star is only of the 7th magnitude. As is the case for nearly all variable stars, the present one has a characteristic spectrum in which the hydrogen lines are extremely strong.

Nitrates in Antarctic Water Specimens.—At a recent meeting of the Academie des Sciences, M. Müntz treated of rain water and snow which were collected by the Charcot antarctic expedition and brought to Paris by Ensign Godfroy. After making a careful analysis of the water specimens, M. Müntz found that rain and snow of the antarctic regions contain as large a proportion of nitrates as those of temperate zones, in spite of the absence of storms. However, as it is recognized that nitrates floating in the air are formed by electric discharges, we may conclude that such nitrates are brought to the south polar regions by north winds from the equatorial regions, knowing that nitrification is intense in these latter.

Dahlias and Potatoes.—By a kind of horticultural irony the dahlia, that popular flower that so often forms a conspicuous display at flower shows, has a dreadfully prosaic parentage. It has been developed from the Mexican tubers introduced about one hundred and twenty years ago by the Swedish naturalist, Dr. Dahl, for the purely commercial purpose of supplementing the potato! The doctor's scheme did not meet with favor, and the dahlia dish soon disappeared from British tables, but the gardeners of the old country at once perceived the great potentialities of the flower, and accordingly proceeded to produce the double dahlia and other delightful floral fantasies. The tubers of the dahlia, too acrid for most tastes, are still eaten in some parts of France.

The Shapes of Eggs.—There was recently had before the Zoological Society of London a mathematical discussion of the differences in the shapes of eggs. A few eggs, like those of the owl and the tortoise, are spherical, or nearly so; a few, like the grebe's or the cormorant's, are elliptical, with symmetrical ends; the great majority, like the hen's, are ovoid, or blunter at one end than the other. The hen's egg is always laid blunt end foremost. Eggs that are the most unsymmetrical are also eggs of large size relatively to the parent bird. The yolks of eggs are spherical, whatever the form of the entire egg may be. This has been shown to be due to their being enclosed in a fluid, the "white," which makes the pressure everywhere on the surface of the yolk practically constant.



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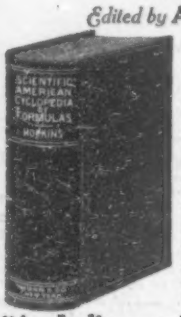

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¶ A table of contents of this number is herewith presented.

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